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897

Vol 50

CONTENTS

No. 1, January, 1933

[Issued February 6, 1933.]

Page.

TALAVERA, FLORENCIO, and LEOPOLDO A. FAUSTINO. Edible mollusks of Manila 1 33
Eighteen plates and six text figures.

ROXAS, HILARIO A. Philippine Alcyonaria: The families Cornulariidæ and Xeniidæ 49 67434
Four plates.

No. 2, February, 1933

[Issued February, 23, 1933.]

GEE, N. GIST. More fresh-water sponges from the Philippines.......... 111 35

TUBANGUI, MARCOS A. Notes on Acanthocephala in the Philippines.. 115 36
Six plates.

ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), XII.......... 129 37
Three plates.

VOSS, EDUARD. Eine erweiterte Bestimmungstabelle des Subgenus Suniops unter dem Genus Euops (Coleoptera; Curculionidæ)...... 163 38
One text figure.

ALSTON, A. H. G. Certain ferns in Sir James Smith's herbarium.... 175 39
One plate.

FLEMING, WM. D. Solar ultraviolet radiometry: I, The ultraviolet limit of sunlight 185 40

HERMANO, A. J., and FÉ ANIDO. Chemical and biological analyses of tikitiki extracts 189 41
Seven text figures.

GARCIA, ONOFRE. Serologic study of cerebrospinal fluids in Philippine monkeys inoculated with yaws, syphilis, or both.......... 199 42

AFRICA, CANDIDO M. An arthropod associated with a chronic dermatitis involving the face 205 43
Two plates.

No. 3, March, 1933

[Issued March 21, 1933.]

SERRANO, F. B., and M. A. PALO. Blossom-blight of mangos in the Philippines 211 44
Seventeen plates.

FLEMING, WM. D. Solar ultraviolet radiometry: II, Instruments and methods 279 45
One plate and five text figures.

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Page.

ISRAELSKY, MERLE C. Echinoids from the Malumbang formation, Philippine Islands 301
Five plates.

SPAETH, FRANZ. Die Hoplionota-Arten von den Philippinen-Inseln (Coleoptera; Chrysomelidæ) 311
One text figure.

RENSCH, BERNHARD. Bericht über "Eine neue Hydrobiidæ von den Philippinen" 325

TOKUNAGA, MASAAKI. A marine crane fly, Limonia (Dicranomyia) trifilamentosa, of the Pacific coast of Japan, with special reference to the ecology and the morphology of its immature stages.... 327
Three plates and two text figures.

No. 4, April, 1933

[Issued April 8, 1933.]

ROXAS, HILARIO A. Philippine Alcyonaria, II. The families Alcyoniidæ and Nephthyidæ........ 345
Five plates.

INDEX 471

THE PHILIPPINE
JOURNAL OF SCIENCE

VOL. 50 JANUARY, 1933 No. 1

EDIBLE MOLLUSKS OF MANILA

By FLORENCIO TALAVERA and LEOPOLDO A. FAUSTINO
Of the Bureau of Science, Manila

EIGHTEEN PLATES AND SIX TEXT FIGURES

The Philippine Islands has furnished the different museums of the world with a great variety of marine, fresh-water, and land shells. As a matter of fact, there are few places in the world that can rival the Philippines as a shell locality. While Philippine shells as ornaments and as objects of beauty and scientific investigations are known the world over and have been the subject of papers and monographs, the food value of the soft parts has not been very seriously studied. As a preliminary to a more-detailed study of the habits, ecology, and life histories of the different shellfishes used as food with a view of promoting the shellfish industries there are here presented records of all the species of shells sold and used as food in and around Manila during the last four years, with notes on their occurrence, habitats, habits, culture, and uses as food. Most of these were actually purchased in various Manila markets; namely, Divisoria, Quinta, Sampaloc, and others, or from street vendors in the more thickly populated districts. The shells are presented in the order of their importance by families and not by following the usual systematic scheme of classification. Practically all these mollusks are sold in their shells, and the shells are the means of identifying them; therefore, a description of the shell is given for each species. As aid to the identification of the shells figs. 1, 2, 3, and 4 give the names of the different parts of the shells.

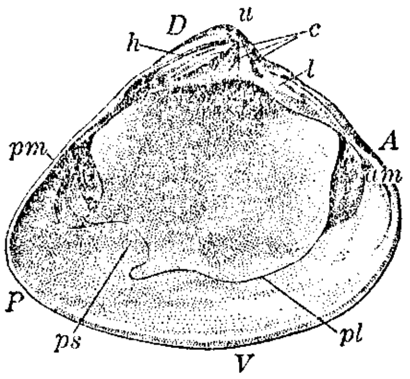

FIG. 1. *Meretrix meretrix* Linnæus, left valve; *A*, anterior end; *P*, posterior end; *D*, dorsal margin; *V*, ventral margin; *AP*, length of shell; *VD*, height of shell; *h*, ligament, or hinge line; *u*, beak, or umbo; *c*, hinge, or cardinal teeth; *l*, lateral tooth; *am*, anterior adductor muscle scar; *pm*, posterior adductor muscle scar; *pl*, pallial line; *ps*, pallial sinus.

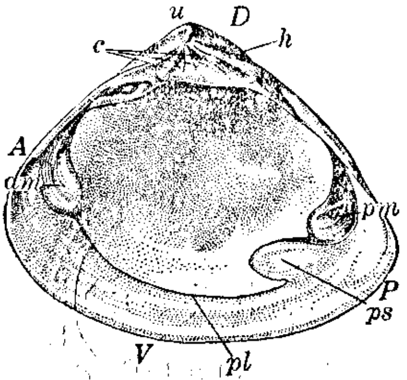

FIG. 2. *Meretrix meretrix* Linnæus, right valve; lettering the same as in fig. 1.

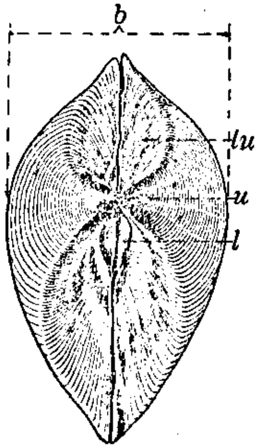

FIG. 3. *Meretrix meretrix* Linnæus; *b*, breadth; *lu*, lunule; *u*, umbo; *l*, ligament area.

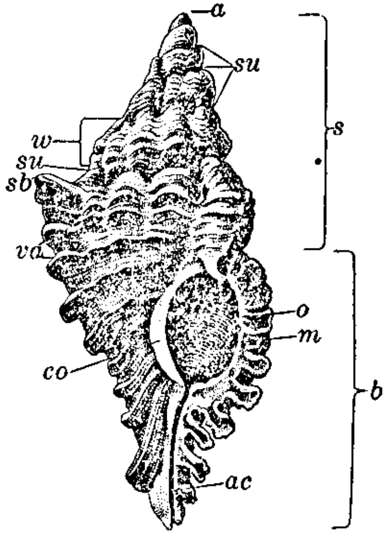

FIG. 4. *Murex torrefactus* Sowerby, young; *a*, apex; *s*, spire; *m*, mouth, or aperture; *o*, outer lip; *ac*, anterior canal; *co*, columella; *va*, varix; *su*, suture; *b*, body whorl; *sb*, shoulder of whorl.

The list of the species considered includes those of all the classes of Mollusca excepting the Cephalopoda. In other words only those with the shells external are taken into account. One species of Brachiopoda is included.

Summary list of the species of mollusks represented in the order of their importance.

Ostrea iredalei Faustino.
Ostrea malabonensis Faustino.
Ostrea palmipes Sowerby.
Arca cepoides Reeve.
Arca binakayanensis Faustino.
Arca antiquata Linnæus.
Arca chalcanthum Reeve.
Arca cornea Reeve.
Arca inæquivalvis Bruguière.
Paphia hiantina Lamarck.
Paphia ferruginea Reeve.
Paphia striata Chemnitz.
Paphia turgida Lamarck.
Circe pectinata Linnæus.
Circe gibba Lamarck.
Circe divaricata Chemnitz.
Circe scripta Linnæus.
Venus (*Anomalocardia*) *squamosa* Linnæus.
Venus (*Anaitis*) *alta* Sowerby, jr.
Mactra mera Deshayes.
Macoma pellucida Philippi.
Soletellina (*Soletellina*) *cumingiana* Deshayes.
Soletellina (*Psammotæa*) *elongata* Lamarck.
Soletellina (*Psammotæa*) *minor* Deshayes.
Mytilus smaragdinus Chemnitz.
Modiolus philippinarum Hanley.
Modiolus metcalfei Hanley.
Pharella acutidens Broderip and Sowerby.
Anatina truncata Lamarck.
Donax radians Lamarck.
Hemidonax donaciforme Schroeter.
Cyrena ventricosa Deshayes.
Corbicula fluminea Müller.
Dalliella subcrassa Lea.
Strombus canarium Linnæus.
Melongena pugilina Born.
Melongena galeodes Lamarck.
Potamides (*Telescopium*) *telescopium* Linnæus.
Potamides (*Cerithidea*) *rhizoporarum* A. Adams.
Potamides (*Terebralia*) *sulcatus* Born.
Umbonium vestiarium Linnæus.
Pila luzonica Reeve.
Vivipara burroughiana Lea.
Thiara asperata Lamarck.
Lingula unguis Linnæus.

OYSTERS

OSTREIDÆ

Other names.—Edible oysters, rock oysters, backwater or mud oysters.

Vernacular names.—Talaba, talabáng talím, "chinelas," kukóng kabayo, pulídpulíd, butíl (Tag.); talaba, sisí (Vis.); tirem (Il.).

OCCURRENCE, HABITAT, AND HABITS

Around Manila Bay three species of oysters of economic importance are found in abundance in shallow water, in estuaries, tideflats, swamps, and fishponds, where they are either exposed or submerged a few feet below the surface during the low tide. The tidal conditions and the temperature of the water are both favorable for the growth and proper development of the oysters. According to the United States Geodetic Survey, for Manila "the greatest range of tide occurs usually in June and December and the smallest range in March and September."[1] The surface temperature of the water in Manila Bay ranges from 24° to 29° C. during the year.[2] Numerous streams discharge their waters into Manila Bay. The largest of these is Pampanga River and its distributaries. The shores of Manila Bay, therefore, receive a good quantity of fresh water, particularly in times of flood and during the rainy season.

Oysters thrive best in water which is neither too salty nor too fresh; that is, where there is a range of salinity represented by variations in specific gravity from 1.010 to 1.025; and whenever the specific gravity of the medium is below 1.010 they greatly suffer; if it continuously falls below 1.007 they either die or become unusable.[3] Likewise, whenever the specific gravity rises above the normal limit they succumb or become useless as breeders. In other words, extreme freshening resulting from too much freshet from the land and streams usually during and after a heavy rainfall, or extraordinary salting of the water due to rapid evaporation during dry warm weather is apt to affect them with disastrous results.

The oysters feed by straining out minute organisms and dissolved animal and vegetable matter from the water which is drawn in by means of the vibrating movement of the fine hairs covering the gills. Salt- or brackish-water diatoms, animal plankton, and finely divided miscellaneous substances are the principal food constituents the oysters obtain from the sea by a sort of filtration. They feed a large part of the time, filtering or drawing in many gallons of water a day. As long as they are breathing the food particles continuously roll or slide along the gills toward the mouth, which is located at the narrow front end of the animal.

However, the feeding activity is hampered by organic slimes and much silt. Large amounts of suspended organic and inorganic matter may suffocate both the adult and the young. While in the swimming stage the attachment of the young is made difficult by the silting of the bottom or any hard object upon which they chance to land; and even after they have gained anchorage, their feeding and breathing processes which are carried on simultaneously are greatly hindered by sedimentation.

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[1] U. S. Coast Pilot, Philippine Islands, pt. 1 (1927) 53.

[2] Selga, Rev. Miguel, Sea Surface Temperatures in the Philippines, Publ. Manila Observatory 3 No. 3 (1932).

[3] Tressler, Donald K., Marine Products of Commerce. The Chemical Catalog Co., New York (1923), Chap. 27, the World's Oyster Industry.

Oysters have a short free-moving life. During the early stage the larvæ are hairy and swim for some days on the upper level of the water drifting along with the tidal currents. Obviously their life during this period is the most precarious. In time the roving creatures, which are easily affected by sudden changes in environment, lose their buoyancy due to the increasing weight of the growing shell. They have then reached the shelled larval or spat stage, the beginning of their sedentary life. Those that survive the adverse condition settle down or set, attaching themselves to any hard object they may chance to fall upon. The horizontal and vertical distribution of the "settlers," also known as "set" or "spat," is influenced by the current velocity of the sea water, waves, natural enemies, and other factors. The spat falling on favorable places in due time develop into "seed oysters" or simply "seeds," which may be collected for transplantation or left where they have settled to grow until harvested.

CULTIVATION

Methods of collecting spat.—In order to initiate a new growth of oysters, a start may be made either with the spat or with the seed oysters. For catching the shelled larvæ various artificial devices are used in different countries, of which the commonest are the fascine collectors made up of brush or bundles of sticks or bamboo branches; bamboo screens; stakes or poles; limed semicylindrical tiles; rectangular wooden plates with thin friable coating of cement or lime mortar; wire crates or cylindrical wire bags containing dead shells of oysters, scallops, or clams; oyster shells threaded on wires which are hung from strands of wire stretched between posts or suspended from rafts or floats; tarred cables or ropes suspended from floats or from ropes running from post to post set into the bottom; and various empty shells and rough stones scattered over the grounds. The United States Bureau of Fisheries has recently introduced an improved method for the collection of spat, which is known as the partition type,[4] consisting of interlocking strips of waterproof cardboard coated with a mixture of cement, sand, and quicklime. This collector is cheap, practicable, suitable for stacking and collecting of spat, and especially for their separation soon after attachment.

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[4] U. S. Bur. Fisheries Document 1076 (1930).

Local cultural methods.—Fascine collectors are rarely if ever utilized in the oyster farms around Manila Bay. In Parañaque, Rizal Province, oyster spat are collected and grown on bamboo rafts; in Kawit, Cavite Province, and Abucay, Bataan Province, they are grown on bamboo stakes, or *tulus*, which are set in rows in the intertidal areas generally during May and June and removed usually after a year when the oysters are harvested. In Navotas and Malabon, Rizal Province, and Obando and Binuangan, Bulacan Province, where the cultivation of oysters is more or less extensive, the method used consists in scattering empty oyster shells on the grounds where oysters are known to spawn and set. Spreading of shells, or cultching, is done from April to October, since the setting of oysters in the region takes place during this period. The cultch or collectors are loaded in bancas from which they are shovelled and scattered indiscriminately over the grounds. The sown shells are known locally as "binhi," meaning seeds, because of the mistaken common belief among the local oystermen that from these "planted" dead shells the young oysters develop. Since the scattered collectors are always exposed to the mercy of the tides, currents, and waves, a great many of them are buried or carried away with the result that they are apt to pile in heaps at certain places, leaving various patches almost if not entirely bare and devoid of cultch. In the oyster farms near Manila such occurrences are unavoidably common, resulting in small harvest or less profit and oftentimes in total loss to the oystermen. Losses through these causes may be minimized if the seed oysters are transplanted to grounds less exposed to unfavorable conditions. In the transplantation or cultivation of oysters several factors need consideration. It is necessary to consider carefully the nature of the bottom. It should not be so soft as to permit the shells to sink and suffocate, and it should not have shifting sand which will cover and smother them. A bottom with much decomposing organic material is unsuitable, as it may generate poisonous gases in sufficient quantity to be harmful. A moderately stiff or fairly hard sticky mud bottom is the most desirable. Oysters thrive well on a rocky bottom, but the harvesting of the crop from such a bed is always a problem. Oyster farms should be in sheltered places, away from heavy seas and river currents, and in water not too deep for practical working.

Modern cultural methods.—The introduction of modern cultural methods would be of practical value and would increase the yield of the local industry considerably. The Chinese and Japanese in Formosa use a unique method which consists of dead oyster shells impaled on bamboo stakes three to four feet in length. Each stake carries from five to ten shells arranged at intervals on the upper portion so that the device is nothing but a long stem with a flowerlike crown of shells. The stakes are planted on the tideflats and the young oysters set on the impaled shells and are allowed to grow thereon until harvested. The Formosans also make use of empty oyster shells threaded on short wires which are suspended from long cables stretched between posts. This system of oyster culture is known as the "hanging method," which is based upon the idea of the "suspended ostreiculture" of the Romans. In Japan it has been extensively utilized to catch spat and grow seeds as well as to fatten adult oysters. The Japanese, however, have found through continuous experiments that a good-sized wooden raft supported on air-tight barrels is a more practical framework than a long line of posts from which to hang short wires carrying shell collectors or ropes. This innovation is now in use in many places in Japan, particularly at Kanazawa and Aburatsubu Bay in Misaki where one of us has observed such rafts for oyster culture.

It has been reported that oysters grown in this manner are not only fattened but also grow large with extreme rapidity.[5] Obviously, the method has distinct advantages since the three dimensions of space in the water may be utilized and because the growing oysters can be easily moved from one place to another as local conditions change, thus insuring more-successful cultivation and a cleaner food product with the least possible contamination.

The feasibility of this system of oyster culture has long been recognized in the United States; however, the method was only recently introduced in California. At Elkhorn Slough near Moss Landing, Watsonville, there is at present an extensive oyster farm under the supervision of a Japanese expert. Imported Japanese seed oysters grown on ropes are used. The ropes, cut to desired lengths, are suspended at regular intervals from well-constructed wooden floats. The culture has been very successful according to a recent report.[6]

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[5] Journ. Imperial Fisheries Inst. 22 No. 4 (1927).

Harvesting and marketing.—In Navotas, Malabon, and Obando, particularly, the fishermen simply dive for the shells and gather them from the bottom with bare hands which are protected only by a wrapping of old rags. Each diver carries a wire basket to hold the catch which is from time to time transferred into a waiting banca. No dredge, scraper, tongs, nippers, or similar implements that can be worked from a banca are in any way employed to collect oysters in these localities. The cultivated grounds are harvested every year, but since it is impossible to gather all the oysters on a farm at any one time, the yield generally consists of shells from one to three years old or older. A load of oysters in a banca 6 meters long, 60 centimeters wide, and about 40 centimeters deep, is worth around 5 pesos at the farms. Most of the crop is marketed in Manila, where the raw mollusks bring from 40 to 80 centavos a hundred. Oysters are sold in the shell or shucked; the shucked meats are usually retailed in cupfuls from earthen jars (palyok), tin or wooden pails, or in heapings placed on banana leaves on the market table. A liter of fresh shucked oysters sells for about 40 centavos at the cultural centers and around 60 centavos in Manila.[7]

In places where the tulus method is used the crop is harvested a year after the placing of the stakes. These are removed or pulled out from the bottom and the attached oysters are chipped off. The yield which consists chiefly of the thin curved oysters is sold at a very much lower price.

From the rock walls of the breakwater at Fort San Antonio Abad oysters are gathered daily by naked divers using a pry, which may be an old bolo, file, or iron rod with which to detach the oysters from the rocks and a pair of water-tight goggles to protect their eyes while locating the mollusks. The oysters obtained here are the kinds that grow to a large size. These are sold at from 40 to 60 centavos a hundred at the premises and for more at the markets where they are in demand because of the fact that they are obtained from a much cleaner ground than the other oyster farms around Manila.

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[6] Calif. Fish and Game 17 No. 3 (1931).

[7] One peso, or 100 centavos, Philippine currency equals 50 cents United States currency.

Oysters can be kept or transported in the fresh state for comparatively long periods, if properly packed in baskets, boxes, or barrels with sufficient seaweed to keep them moist. They stand removal from the water with remarkable endurance due to their surprising ability to hold the shells tightly closed for a long time. This remarkable power to live out of water for several days is explained by the fact that under normal conditions oysters in shallow water are subjected to daily exposure to sun and air during low tide, and this has undoubtedly brought about in the shellfish this adaptability. Endurance tests conducted with local species under normal laboratory room temperatures obtaining during March, April, and May in Manila (21° C. to 34.9° C.), have shown that *Ostrea iredalei* Faustino can live out of water for six days; *Ostrea malabonensis* Faustino for about five days; and *Ostrea palmipes* Sowerby for about three days.

Status of fisheries.—The farms in Navotas and Malabon are worked by private individuals, who apparently pay no municipal fees for the more or less exclusive privilege they enjoy. The oyster grounds in Obando, Bulacan, and Binakayan, Kawit, are run on the lease system. Plats are leased to tenants by the municipality, and the lessees are amply protected. Oysters are not taken from leased grounds any more than rice is taken from a man's rice field. There are, however, natural oyster beds in many places around Manila Bay that are being utilized as public fisheries; that is, where oysters are gathered without permit of any kind.

UTILIZATION

Philippine oysters are extensively used as food. Because of their excellent flavor they are always appetizing when eaten raw. All the soft parts are edible. Great quantities of fresh oysters find their way into the "panciterias," or Chinese restaurants, where they are prepared in various tasty dishes. Considerable amounts are also used by Filipino food vendors and housewives in the making of a number of Filipino dishes sufficiently tempting to even the most fastidious epicures. The simplest and commonest way of preparing oysters for the table is to steam them open in the shell; the meat is extracted and eaten plain or with a vinegar sauce. Another way is to shuck fresh oysters and pickle the raw meat in vinegar seasoned with onion, salt, and pepper. Oysters are also pickled in salt and bottled.

In the vicinity of oyster farms and in places where the mollusks are shucked there are piles of old shells. These are utilized primarily for cultching and for the manufacture of lime.

DESCRIPTION OF THE SPECIES

The commonest species of oysters encountered in Manila Bay are *Ostrea iredalei* Faustino, *Ostrea malabonensis* Faustino, and *Ostrea palmipes* Sowerby. *Ostrea iredalei* Faustino is the largest of the three species and is easily recognized by the chalky white interior and the purple muscle scar. The other two are small but have a delicate flavor. They are the ones to which the local name "pulidpulid" or "butil" is applied. *Ostrea palmipes* Sowerby is rather thin but fairly marketable. *Ostrea palmipes* may be distinguished from *Ostrea malabonensis* by the fact that the lower valve of the former has the appearance of a webbed foot of a bird while the lower valve of the latter has the appearance of a horse's hoof.

OSTREA IREDALEI **Faustino. Plate 1, figs. 1 and 2; Plate 2, figs. 1 to 3.**

The shell is somewhat variable in shape depending largely upon the object and mode of attachment. Those growing in bunches are elongate, sometimes tongue-shaped, sometimes obliquely triangular, and sometimes oblong. The exterior of the shell is very foliaceous, and the beak is prominent.

The lower, or left, valve is slightly excavated and generally has a purple tint. The upper valve is smaller, thinner, flatter, generally yellowish brown, sometimes with faint radiating rays of purple, covered with thin laminæ, and scaly at the margins.

The hinge is toothless, and the valve margins inside are smooth. The interior of the shell is chalky white, and the muscle scar is purple.

Length, 30 to 80 millimeters.

OSTREA MALABONENSIS **Faustino. Plate 1, figs. 3 to 6; Plate 3, fig. 4.**

The shell is not large, in some cases roughly triangular in shape, in others irregularly oblong, and is solid. This species is not usually found in clusters, but is generally attached singly to other shells.

The lower valve is concave, deep, and plaited. The plaits are rounded, large, and numerous. The upper valve is plain though sometimes it is also plaited at the margin.

The interior of the shell has greenish brown spots, and the valve margins near the hinge are toothed.

Length, 25 to 45 millimeters.

OSTREA PALMIPES Sowerby. Plate 3, figs. 1 to 3.

The shell is thin and is much compressed. The shape is more or less square with rounded corners. Generally the shells are flat but when attached to a rounded surface like the surface of bamboo poles they become concave.

The lower valve is expanded beyond the upper and is radiately ribbed; the ribs are tuberculated. The upper valve is smooth, smaller, and obscurely rayed. The interior of the shell is greenish brown, and the valve margins near the hinge are toothed.

Length, 40 to 60 millimeters.

ARK SHELLS

ARCIDÆ

Other names.—Chest shells, blood clams, rock cockles, arcas.

Vernacular names.—Halaan, halaan lalake, bototoy, litob, litog, bilogan, bígatan (Tag.); litog, suliut, balisá, bakalan (Vis.).

OCCURRENCE, HABITAT, AND HABITS

More than forty species of ark shells are found in the Philippines, occurring in bays or exposed beaches with sandy or muddy bottom and on reefs and among rocks in shallow water. In Manila Bay no less than six species are found along the shores of Pasay, Parañaque, Binakayan, and Kawit where the most important natural beds exist; they also occur along the northern and western shores of Manila Bay, from Navotas, Rizal Province, to Balanga, Bataan Province.

These mollusks are active shallow burrowing bivalves and have a strong elongated foot but no siphon tube; they are primarily vegetarians, subsisting upon microscopic plants from the water drawn in and out through the holes that are formed by the fusion of the mantle margins at two points. They are very prolific; the fry after quitting the free-swimming stage tend to settle in definite areas in great quantities. Apparently, in Manila Bay they spawn continuously throughout the year. At Parañaque small and large ark shells are noticeably abundant during April, May, and June, which would seem to indicate that the height of the spawning period of the clams in this locality is probably during December and January. Although their rate of growth is not definitely known, it is believed that under the local conditions the arcas may attain a marketable size in less than two years.

METHOD OF COLLECTION

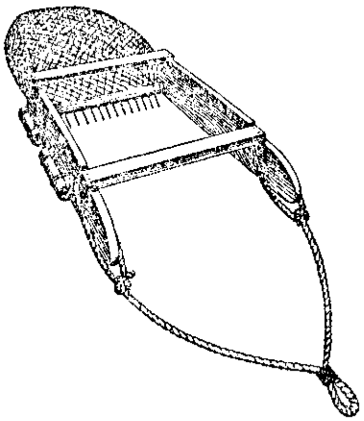

FIG. 5. The kulakud.

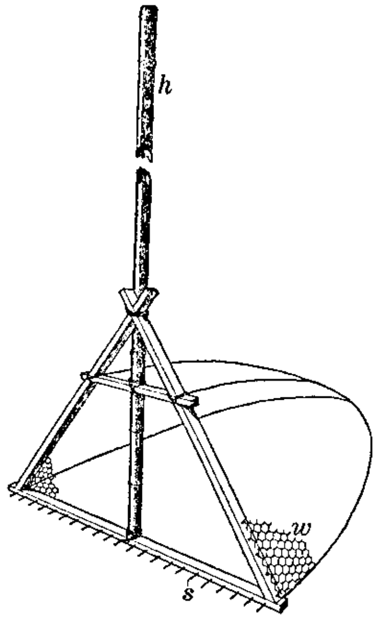

FIG. 6. The pañgahig; *h*, handle; *s*, iron nails; *w*, wire netting.

At Pasay, Parañaque, and Binakayan, where fishing for arcas is an industry of considerable importance, the native fishermen use a number of collecting devices. One of these is the crude but unique *kulakud* (fig. 5), which consists of a pair of wooden rectangular skids, each about 70 centimeters wide and 2 centimeters thick, and a bag net attached behind the boards. The lower frame of the mouth carries a number of perpendicularly directed iron teeth serving as rakes. Iron weights are tied to the outer side of each board in order to increase the weight of the implement. To the forward ends of the skids a rope about 2 meters long is attached to make a bridle to which the pull rope is tied. The kulakud is operated in water about 5 meters deep by two men from a banca with an outrigger on one side only. The implement is carefully lowered into the water so that on landing the rakes rest on the ground; the banca is taken to a distance of about 30 meters and there held fast to a bamboo pole well driven into the bottom; then the pull rope is hauled in, and the catch after being washed of dirt is emptied into the banca. Another implement used is the long-handled rake dredge, the *pañgahig* (fig. 6), which is worked by one man from a banca. A triangular dredge sieve made up of bamboo splints is also used. On the exposed areas during low tide arcas are collected by sifting the ground with the fingers.

UTILIZATION

The abundance of empty ark shells near seashore homes around Manila Bay is evidence that the mollusks are extensively used as food. The clams are gathered alive and prepared for the table in various ways. They are generally steamed open in the shell with slices of ginger root to flavor the resulting juice or broth; the steamed meats are eaten plain or seasoned with some sauce. The fresh arcas are also shucked and the raw meats are used as a basis for some native dishes, or pickled in vinegar and bottled. In the public markets fresh blood clams sell for from 10 to 50 centavos a hundred, depending upon the size. The empty shells are utilized in the manufacture of lime. In Parañaque there is a lime factory that uses great quantities of arcas.

DESCRIPTION OF THE SPECIES

Of the species sold in the markets and used as food the commonest are *Arca cepoides* Reeve, *Arca binakayanensis* Faustino, and *Arca antiquata* Linnæus. *Arca inæquivalvis* Bruguière is the largest species encountered. *Arca antiquata* Linnæus, *Arca chalcanthum* Reeve, and *Arca cornea* Reeve are found occasionally.

ARCA CEPOIDES Reeve. Plate 7, figs. 5 and 6.

The shell is somewhat squarely egg-shaped, thin, and inequivalved. The sides are angulated at the upper part, the anterior end is somewhat rounded, and the posterior end is a right angle. The exterior is white and is covered with a thin brown epidermis, which is scaly between the ribs. The ribs radiate from the umbo, are 31 to 33 in number, and are smooth and flat. There are a few on the left valve that are somewhat broader than those on the right valve.

Length, 42 to 45 millimeters; height, 38 to 40; breadth, 28 to 32.

ARCA BINAKAYANENSIS Faustino. Plate 7, figs. 3 and 4.

The shell is nearly square, thick, and inequivalved. The left valve extends beyond the right valve. The sides are angulated at the upper part, the anterior end is somewhat rounded, and the posterior is almost a right angle. The exterior is white and is covered with a thin brown scaly epidermis, which comes off easily. It is radiately ribbed. On several specimens there are 34 ribs. The ribs are flat and fairly smooth. A few on the left valve are somewhat larger than those on the right valve.

Length, 45 to 55 millimeters; height, 40 to 50; breadth, 33 to 38.

ARCA ANTIQUATA Linnæus. Plate 7, figs. 1 and 2.

The shell is obliquely heart-shaped, thick, and rather gibbous. It is equivalved with the sides angulated at the upper part. The anterior end is somewhat rounded and short, and the posterior end is obtusely extended. The exterior is whitish, is coated with a brown hairy epidermis, and is radiately ribbed. The ribs number 30, are comparatively narrow, and are sharp-edged. They are nodulously decorated toward the umbo. The inside is white and is marked with numerous shallow radiating grooves.

Length, 44 to 50 millimeters; height, 34 to 39; breadth, 30 to 36.

ARCA CHALCANTHUM Reeve. Plate 8, figs. 1 and 2.

The shell is oblong, somewhat compressed, and inequivalved. The sides are angulated at the upper part, the anterior end is short and rounded, and the posterior end is longer and much compressed. The exterior is whitish and is covered with a green horny cuticle, over which is a hairy brown epidermis. It is radiately ribbed, the ribs number 28; the inside is bluish white and is marked with numerous radiating grooves.

Length, 33 to 38 millimeters; height, 21 to 23; breadth, 15 to 17.

ARCA CORNEA Reeve. Plate 8, figs. 3 and 4.

The shell is somewhat square, rather gibbous, and inequivalved. The anterior end is short and rounded, but the posterior end is longer and is slightly obtusely angled. The exterior is whitish and is covered with a green horny cuticle, over which is a scaly brown epidermis. It is radiately ribbed, and the ribs number 29. The ribs on the right valve are flat and smooth; those on the left valve are nodulously decorated.

Length, 25 to 30 millimeters; height, 19 to 25; breadth, 16 to 20.

ARCA INÆQUIVALVIS Bruguière. Plate 8, figs. 5 and 6.

This shell is large, elongately egg-shaped, and inequivalved. The sides are angulated at the upper part, the anterior end is short, and the posterior end is obtusely angled. The exterior is whitish and is covered with a thin brown epidermis, scaly between the ribs. It is radiately ribbed, and the ribs number 32 or 33. They are smooth, flat, and regular. The ligament area is rather narrow.

Length, 70 millimeters; height, 60; breadth, 50.

SAND CLAMS

VENERIDÆ

Other names.—For *Paphias,* surf clams, hard-shell clams, skimmers. For *Circes,* small clams, cockle clams, ridged sand clams. For *Venus,* Venus clams, waved sand clams.

Vernacular names.—For *Paphias,* halaan, halaan babae, kabiâ, punao, patayóg (Tag.); punao, paróng manók (Vis.). For *Circes,* bígatan, kalumismis, kamotpusâ, sarópsarópan, tambayáng babae (Tag.); búgatan (Vis.); daroparpar (Il.). For *Venus,* butíl, kanturî, moran (Tag.).

OCCURRENCE, HABITAT, AND HABITS

The Veneridæ include clams that are mainly littoral in occurrence and require a clean habitat and strong tidal current over the grounds where they live, so that they are usually found on open seashores and near the entrance to a lagoon or large stream where the tidal flow is great. Around Manila Bay the sand clams are limited to sandy shores or beaches that are exposed to the constant rushing and beating of the surf. They are found much scattered and do not grow in regular beds. The clams are constantly active. As the waves sweep the shore they try to gain a foothold by their large muscular foot, which enables them to work their way down to prevent being buried too deeply or dislodged and thrown to the mercy of the elements.

These actively burrowing bivalves have short siphons. The exhalent tube is shorter than the inhalent and is provided with a delicate thin-walled tip, rimmed with minute short projections. The opening is tightly closed when not in use, and when opened the entrance of sand is prevented by the outflowing current from the tube. The inhalent siphon has an enlarged tip and terminates in a broad flat surface provided with an aperture that is closed by a delicate system of closely placed branched tentacles, which strain off every bit of sand as the water containing oxygen and food passes to the mantle cavity.

METHOD OF COLLECTION

Under ordinary conditions the clams are located by feeling with the fingers or toes or with some hard implement. On undisturbed beaches their location may be recognized by tiny holes overlying the whole shell. The smaller forms are generally obtained by sifting the sand with the fingers. The sandy stretches of Balanga, Malabon, Navotas, Pasay, Parañaque, and Cavite are the principal grounds from which considerable amounts of these sand clams are gathered by the inhabitants living along the shores.

UTILIZATION

These clams are among the best and most liked of the food mollusks and are regularly marketed and extensively used. Every part of the meat is eaten. The flesh is prepared as various savory dishes; the variety, indeed, shows the high regard in which the clams are held. The preparatory operation is to steam the shells open and remove the flesh. The broth resulting from steamed clams is delicious. In the public markets the clams are sold alive; the larger forms bring from 10 to 20 centavos a hundred, the smaller ones much less.

DESCRIPTION OF THE SPECIES

The commonest species that are marketed in large numbers are *Paphia hiantina* Lamarck, *Paphia ferruginea* Reeve, *Circe pectinata* Linnæus, *Circe gibba* Lamarck, *Circe divaricata* Chemnitz, *Circe scripta* Linnæus, *Venus* (*Anomalocardia*) *squamosa* Linnæus, and *Venus* (*Anaitis*) *alta* Sowerby, jr. *Paphia striata* Chemnitz and *Paphia turgida* Lamarck are also sometimes encountered.

PAPHIA HIANTINA Lamarck. Plate 3, figs. 5 and 6.

The shell is somewhat squarely egg-shaped, with the posterior end obliquely truncated. The color is variable, sometimes light gray, other times reddish yellow or light yellow, with or without netted flamed markings radiating from the umbo. The shell is concentrically ridged; the ridges are somewhat flattened at the center but rather sharp toward the posterior end. The interior of the shell is orange, but near the hinge the shell is pale blue.

Length, 53 millimeters; height, 42; breadth, 33. These measurements are for the larger shells. Smaller shells are also collected and sold in great numbers.

PAPHIA FERRUGINEA Reeve. Plate 4, figs. 1 to 5.

The shell is elongately egg-shaped, sometimes rather compressed. The color varies from light to reddish yellow. The exterior is characteristically wave-clouded with rust and is concentrically ridged. The ridges are rather irregular.

Length, 30 millimeters; height, 23; breadth, 16.

PAPHIA STRIATA Chemnitz. Plate 4, figs. 6 and 7.

The shell has its posterior end wavily tapering, and the anterior end is tumidly heart-shaped. The color is reddish yellow. The shell is concentrically ridged, the ridges sometimes confluent.

Length, 42 millimeters; height, 35; breadth, 24.

PAPHIA TURGIDA Lamarck. Plate 4, figs. 8 and 9.

The shell is somewhat squarely oblong with the posterior end obtusely angled. The color is light yellowish brown with dark brown spots marking the direction of rays from the umbo. The concentric fine ridges are sometimes confluent toward the posterior and anterior ends. The interior of the shell is orange yellow.

Length, 46 millimeters; height, 32; breadth, 18.

CIRCE PECTINATA Linnæus. Plate 5, figs. 3, 4, and 8.

The shell is elongately oval and compressed. It is whitish, and radiately ribbed; the ribs larger and farther apart at the middle; smaller, nearer each other, and more irregular toward the anterior end, sometimes bifurcating toward the ventral margin. They are nodosely grained, and the nodules are concentrically arranged. The posterior end is plaited, the plaits diverging widely.

Length, 37 millimeters; height, 31; breadth, 18.

CIRCE GIBBA Lamarck. Plate 5, figs. 1, 2, and 7.

The shell is elongately egg-shaped, gibbous, and whitish. It is radiately ribbed; the ribs are larger and farther apart at the middle; smaller, nearer each other, and more irregular toward the anterior end, sometimes bifurcating toward the ventral margin. They are nodosely grained; the nodules are concentrically arranged, much smaller and closer together toward the margin. The posterior end is plaited, the plaits diverging widely.

Length, 35 millimeters; height, 31; breadth, 21.

CIRCE DIVARICATA Chemnitz. Plate 5, figs. 5 and 6.

The shell is elongately oval and rather gibbous. The exterior is reddish yellow to whitish, with reddish brown linear markings, which are interruptedly radiating. It is concentrically and irregularly ridged and also radiately ribbed with the crossings more or less conspicuously granulated. The ribs radiating from the umbo bifurcate or branch before reaching the ventral margin.

Length, 44 millimeters; height, 35; breadth, 24.

CIRCE SCRIPTA Linnæus. Plate 6, figs. 1 and 2.

The shell is somewhat squarely lens-shaped and compressed, with the posterior end obtusely angled. The exterior is reddish yellow to whitish and is linearly waved with dark brown markings. It is also sometimes biradiately blotched. It is concentrically ridged, the ridges fine and close together.

Length, 47 millimeters; height, 43; breadth, 16.

VENUS (ANOMALOCARDIA) SQUAMOSA Linnæus. Plate 6, figs. 5 and 6.

The shell is subtriangular and rather gibbous, more or less swelling out. The posterior end is wavily tapering. The color is whitish. The exterior is radiately ridged, the ridges close-set. The concentric undulations on the ridges simulate latticed sculpture. The margins are finely notched within. The lunule is large.

Length, 23 millimeters; height, 19; breadth, 15.

VENUS (ANAITIS) ALTA Sowerby, Jr. Plate 6 figs. 3 and 4.

The shell is obliquely subtriangular and thick. The exterior is whitish and broadly rayed with flesh purple. It is concentrically laminated, the laminæ are a little reflected and slightly produced, not so much raised in front and leaving a space between their terminations and the lunule. The ligament area is large and broadly excavated, and is deep violet-purple. The dorsal margin is slightly curved.

Length, 23 millimeters; height, 19; breadth, 14.

HEN CLAMS

MACTRIDÆ

Other names.—Mactrids, mactras, large surf clams, giant clams.

Vernacular names.—Katakao (Tag.); punao (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The mactrids inhabit sandy bottoms. Several species have been reported around Manila Bay, notably near Parañaque and Bacoor.

The hen clams are natural, active, shallow burrowers, living buried just below the surface of the sand, and are rather migratory in habit, moving up or down the shore in accordance with the direction of the current. They appear to remain at about the same position relative to sea-level on the shore all the year round; that is, about midway between half tide and extreme low tide. The clams can extend their foot to a distance of a few centimeters in search of food; they also use this organ for anchorage and locomotion as well.

METHOD OF COLLECTION

These mollusks are gathered at low tide; those buried in the sand are secured with the aid of some hard implement, such as an old bolo, with which the sand is scratched to locate them and with which they are dug out, one by one; those left exposed by the tide are simply picked up. A fork similar to that used for digging potatoes or a garden rake would be a very effective tool for getting them out.

UTILIZATION

The hen clams are extensively utilized as food. They are obtained alive from the natural beds at Parañaque, Bacoor, Navotas, and Malabon and are prepared for the table in very simple ways. They are steamed or parboiled in the shell, and the cooked meats are eaten plain or with some sauce, while the resulting juice is consumed as soup. Fresh clams are also shucked, and the raw meats are prepared as a basis for various dishes. Some epicures consider the hen clams, if nicely prepared, just as palatable as oysters. In the public markets the hen clams are sold in the shell for from 20 to 50 centavos a hundred. No fresh shucked hen clams are marketed.

DESCRIPTION OF THE SPECIES

Only one species is marketed in any quantity, and this is *Mactra mera* Deshayes (*Mactra antiquata* Reeve, non Spengler.)

MACTRA MERA Deshayes. Plate 6, figs. 7 and 8.

The shell is triangularly egg-shaped. It is inflated, equilateral, smooth, and shining. The color is generally rich purplish brown, finely white-rayed, deep violet at the umboes. The exterior is concentrically, densely, finely striated. The inside is smooth and violet. The sinus of the mantle is broad and rounded.

Length, 54 millimeters; height, 41; breadth, 25. Much larger shells are also encountered.

SUNSET AND MACOMA SHELLS

GARIIDÆ AND TELLINIDÆ

Other names.—Rayed shells, tellens.

Vernacular names.—Paros, parosparosan, tihim, sulib, karaniwan (Tag.); batitis, bayoyan (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The sunset shells inhabit sandy shores of open seacoasts and sheltered bays. Around Manila Bay they occur in more or less extensive beds on the intertidal areas in Bacoor Bay east of Cavite and around Bataan. They burrow just below the surface and are more or less stationary in habit. They are active diggers and have long, slender, and separate siphons, which are used both for food getting and for locomotion.

METHOD OF COLLECTION

The smaller shells are generally collected by simply sifting the ground with the fingers or by the use of a panlike dredge-sieve made of bamboo splints, with which to separate the clams from the sand. The larger shells generally burrow 20 or 30 centimeters below the surface. A small bamboo or wooden stick lowered into the hole is grasped by the shell so that it can be easily pulled out.

UTILIZATION

The sunset shells are among the most valued of bivalves and are used extensively for food by the Filipinos. When boiled or steamed in the shell they produce an excellent broth. They are shucked and the meat is prepared as soup or chowder.

A favorite method of preparing paros for the table is known in the vernacular as "sinobukan," which is made in this manner: Fresh paros bought in the market or gathered from the shore are washed and "floated" in a basin of water in order that they may free themselves of sand or dirt contained in their intestinal tract. As soon as they open their shells, boiling water is poured into the basin to kill and partially cook the animal. All the water is now drained off, care being taken not to separate the valves so as to provide a handle to each cooked clam. The diner now picks up a paros by its empty valve and before consuming it soaks the meat in vinegar sauce seasoned with salt, sometimes with finely chopped onions, a dash of white pepper, and a little salt.

In the public markets these mollusks are sold alive and bring from 10 to 15 centavos per kilogram.

DESCRIPTION OF THE SPECIES

The commonest species sold in the markets is *Soletellina (Psammotæa) elongata* Lamarck. *Soletellina (Psammotæa) minor* Deshayes, *Soletellina (Soletellina) cumingiana* Deshayes, all of the family Gariidæ, and *Macoma pellucida* Philippi, of the family Tellinidæ, are also gathered in quantities for home consumption. The suggestion has been made that *S. minor* is merely the young form of *S. elongata,* but our studies are not sufficiently advanced to warrant any definite conclusion.

SOLETELLINA (PSAMMOTÆA) ELONGATA Lamarck. Plate 10, figs. 4 and 5.

The shell is elongately transverse and rather gibbous. It is somewhat solid and more or less inequilateral. The exterior is purplish white, covered near the margin with a fibrous dark brown or yellowish brown epidermis. The shell is finely striated. The anterior end is shorter and slantingly rounded, while the posterior end is somewhat obtusely angled. The interior is characteristically deep violet.

Length, 71 millimeters; height, 37; breadth, 20.

SOLETELLINA (PSAMMOTÆA) MINOR Deshayes. Plate 9, figs. 6 and 7.

The shell is transversely egg-shaped and compressed. It is thin and nearly equilateral. The exterior is greenish yellow and obscurely rayed with violet. The anterior end is somewhat rounded, the posterior end is slightly drawn out. The interior is tinged with violet.

Length, 23 millimeters; height, 14; breadth, 7.

SOLETELLINA (SOLETELLINA) CUMINGIANA Deshayes. Plate 9, figs. 3 to 5.

The shell is elongately egg-shaped and slightly compressed. It is equilateral and concentrically striated. The exterior is purple-blue covered with a brownish epidermis. The anterior end is broader than the posterior end, which is slightly wavily impressed. It is inconspicuously two-rayed from the umbo. The interior varies from purple to purplish white.

Length, 72 millimeters; height, 35; breadth, 15.

MACOMA PELLUCIDA Philippi. Plate 9, figs. 1 and 2.

The shell is more or less egg-shaped, thin, and equally convex. It is glossy white, both within and without, is smooth, and has very fine concentric lines. The anterior end is rounded with the dorsal side convex and sloping. The posterior end has a small flexure and is also sloping. The ventral margin is slightly arched and is sloping upward posteriorly. The umboes are small, and the ligament area is small. The hinge margin is thin, and the teeth are minute.

Length, 18 millimeters; height, 15; breadth, 7.

SALT-WATER MUSSELS

MYTILIDÆ

Other names.—Sea or bay mussels, brown mussels, green mussels, weaving mussels, horse mussels.

Vernacular names.—Amahong, tahong, tehong (Tag.); tahong (Vis.); saytil (Il.).

OCCURRENCE, HABITAT, AND HABITS

The Mytilidæ are a large family of bivalved mollusks and include three principal groups or genera; namely, *Mytilus*, a world-wide gregarious genus of sea or bay mussels; *Modiolus*, or horse mussels; and *Lithophagus*, or rock eaters. All of these genera are represented in Manila Bay. The sea or bay mussels are found attached by means of the byssus to hard objects in more or less dense groups, in intertidal areas exposed to the washing of the surf; in fact, wherever there are ideal objects for attachment such as rocks or piles of wood or stones on the coasts or in bays, the sea or bay mussels are almost always to be found in large numbers; however, they do not thrive abundantly in quiet waters. The horse mussels occur singly and are generally encountered partially buried in mud or gravel. They get their nourishment by straining the detritus or dissolved organic matter from the water. The rock eaters make their homes in rocks which they riddle with vertical burrows. Their cylindrical shape and rough surface are peculiarities which bear directly upon their habits. In Manila Bay two species of *Modiolus* occur abundantly along the shores of Parañaque, Navotas, and Malabon; the green *Mytilus* are quite plentiful on the walls of the breakwater in front of Fort San Antonio Abad; however, the rock eaters are nowhere abundant in this bay.

UTILIZATION

The salt-water mussels can be cheaply collected and are extensively used as food. The meat is quite large and tender and has a characteristic flavor considered by some people as being superior to that of any other bivalve not excepting the edible oysters. The mussels are steamed or parboiled in the shell; they are also shucked and the raw meat is pickled in salt or vinegar and bottled. In the local markets fresh mussels in the shell bring from 5 to 10 centavos a dozen.

DESCRIPTION OF THE SPECIES

Three species are commonly found in the markets; namely, *Mytilus smaragdinus* Chemnitz, *Modiolus philippinarum* Hanley, and *Modiolus metcalfei* Hanley.

MYTILUS SMARAGDINUS Chemnitz. Plate 11, fig. 1; Plate 13, figs. 1 to 3.

The shell is subtriangular to elongately oblong in shape. The exterior is reddish brown, covered with a green epidermis, which is bright green toward the margin. It is concentrically, densely and finely striated. The anterior end is slopingly angled, and the posterior end is nearly straight. The shell is slightly arched in the middle. The right valve has two teeth, and the left valve has only one. The interior of the shell is somewhat pearly.

Length, 50 to 100 millimeters; breadth, 23 to 34.

MODIOLUS PHILIPPINARUM Hanley. Plate 10, fig. 3; Plate 11, fig. 4.

The shell is oblong-trapeziform and swollen. The exterior is yellowish brown and rayed, though sometimes obscurely. The anterior end is more or less distinctly incurved, and the posterior end is more or less rounded. The shell is concentrically, finely and densely striated. The interior of the shell varies from whitish to deep violet.

Length, 55 millimeters; breadth, 34.

MODIOLUS METCALFEI Hanley. Plate 11, figs. 2 and 3.

The shell is triangularly oblong and swollen. The exterior is greenish to yellowish brown with a band radiately descending from the umbo. It is smooth or very finely striated, in some specimens half covered toward the margin with a hairy brown epidermis. The posterior end is produced into a compressed wing, more keeled than that of *M. philippinarum* Hanley.

Length, 46 millimeters; breadth, 23.

JACKKNIFE CLAMS

SOLENIDÆ

Other names.—Elongated sea clams, "razor" clams, "razor" shells.

Vernacular names.—Tikhan, tikan (Tag.); tikhan, bilaog (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The jackknife clams, incorrectly called "razor" clams, belong to a family of agile bivalves occurring in sheltered places where they live buried vertically and deeply in sand and mud. Being elongated and roughly cylindrical the clams are naturally adapted for burrowing, each digging a rather smooth-line permanent burrow, 15 to 40 centimeters deep, within which it can move readily up and down. These mollusks are highly sensitive to disturbance and the quickness with which they retreat to a level of safety in the burrow is quite remarkable. When the ground is jarred by footsteps or by some hard object striking the soil the neck is withdrawn, leaving a depression in the sand, which reveals the location of the clam, and invariably a jet of water spouts up as the siphons are retracted; simultaneously, the foot, like a thin knife blade, flies out and cuts through the sand in an oblique downward course; then as the foot contracts its tip dilates forming a bulb which anchors it while the contraction draws the shell downward. This mechanical action of thrust and pull is repeated until the clam reaches the bottom of the burrow or beyond it if possible and necessary. Naturally, if the clam is not dug out quickly it will descend to a place of safety beyond the reach of the digger.

Jackknife clams have eyes in the form of ocelli or pigment spots, bordering the mantle margin around the siphons, and it is claimed that by means of these spots they can distinguish light from darkness to a remarkable degree, so much so that a shadow cast over them will cause the sudden withdrawal of the protruding siphons.

In water, these cylindrical mollusks are proficient swimmers, darting here and there with remarkable celerity by snapping their two valves together. When a clam is captured it generally rehearses its burrowing propensity by rapidly extending and retracting its foot. When it is dropped on the sand it automatically works its way downward at the rate of several centimeters a minute.

METHOD OF COLLECTION

Because of their alertness and quickness to retreat rapidly upon being disturbed or alarmed, jackknife clams are not easy to gather and methods employed in taking other clams in which the ground is systematically dug over would be impracticable. Collectors working on the edge of the surf or on the exposed area on the shore watch for the holes to appear in the sand and dig the clams, one at a time, with the fingers or with an old bolo. In grounds where the clams are known to live but show no outside evidence of their presence, the diggers usually tap the ground with their feet or with some hard implement in order to force the creatures to move downward, thus betraying their location by a slight depression over each withdrawing individual. In water about waist deep the diggers explore the sandy bottom with the foot for razor clams. These are seized between the first and second toes, or are dived for and picked up with the hands.

UTILIZATION

Jackknife clams are extensively used as food. They are generally steamed or parboiled in the shell; the meats are tender and of a delicate flavor and make excellent soup or broth. The fresh clams are also shucked and the raw meats minced and prepared in various simple native ways. In the fish shops in Manila the clams are sold in the shell for about 10 centavos a kilogram.

DESCRIPTION OF THE SPECIES

The lone representative of jackknife clams in the Manila markets is *Pharella acutidens* Broderip and Sowerby.

PHARELLA ACUTIDENS Broderip and Sowerby. Plate 11, fig. 5; Plate 12, fig. 1.

The shell is elongated, narrow, and thin. The hinge line is nearly central with the anterior side shorter. The ventral margin is a little contracted. The exterior is covered with a thin dark brown or yellowish brown epidermis, which does not come off easily. It has fine concentric striations. The interior of the shell is yellow, turning to bluish white upon exposure.

Length, 70 to 74 millimeters; height, 15 to 16; breadth, 9 to 10.

DUCK-BILL CLAMS

ANATINIDÆ

Other names.—Truncated duck-bill shells, anatinas.

Vernacular name.—Lutos (Tag.).

OCCURRENCE, HABITAT, AND HABITS

The Anatinidæ are represented in the Philippines by about ten distinct forms of duck-bill clams, where they occur in muddy bottoms in the shallows along the coasts and in sheltered bays. In Manila Bay one species occurs quite abundantly at Navotas, Malabon, and Parañaque. This clam makes a deep vertical burrow which its shell fits snugly and within which it moves readily up and down. The burrow extends perpendicularly some 30 centimeters or more. Normally, the clam stays below the surface at a distance almost equal to its own length, from which level it extends its long neck upward; this beaklike extension gapes to allow the united and sheathed siphon tube to protrude. The animal is very sensitive to disturbance and withdraws itself suddenly whenever threatened.

UTILIZATION

The lutos is extensively utilized as food by the inhabitants living within reach of the beds, from which it is gathered alive by simply digging it out. The fresh clam is steamed or parboiled; and the meat, which is large and delicious, is eaten plain or with some sauce. In the markets live lutos are sold for 25 to 30 centavos a hundred.

DESCRIPTION OF THE SPECIES

The only species that is sometimes encountered in the Manila markets is *Anatina truncata* Lamarck.

ANATINA TRUNCATA Lamarck. Plate 12, figs. 2 and 3.

The shell is elongately oblong, thin, and translucent. The anterior end is squarely truncated, largely gaping, while the posterior end is compressedly rounded and but moderately gaping. The umboes are more or less fissured and are directed backwards. The shell is concentrically wrinkled and granulated; the granules, however, are abruptly absent on the anterior area.

Length, 48 millimeters; height, 22; breadth, 16.

WEDGE SHELLS

DONACIDÆ

Other names.—Mural, bean clams, minute sand clams, "pompano" shells.

Vernacular names.—Alamis (Tag.); polopatanî (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The wedge shells are small mollusks found on sandy beaches or behind sand bars. In their natural habitat the wedge shells are usually encountered at the surface or slightly buried with the broadside towards the sea. Because of the comparatively heavy weight of their shells they are not easily carried back and forth by the waves; they can maintain their position on the sand by the aid of their foot which is quite large, elastic, and pointed; this is thrust obliquely outward and downward and dug into the wet sand, lifting the shell and drawing it under cover. Thus, in a way, the wedge shells are more or less active surface burrowers and as such can be easily collected by sifting the sand with the fingers or with a dredge-sieve made of bamboo splints.

UTILIZATION

The bean clams are among the best flavored of the small sand bivalves marketed. They are simply steamed or parboiled in their shells and make an excellent basis of a delicious soup. In the public markets fresh bean clams are sold for about 5 centavos a kilogram. The empty shells are used in lime making.

DESCRIPTION OF THE SPECIES

While there are several species of *Donax* reported from Manila Bay only one is sold in any quantity in the Manila markets. The lone species is *Donax radians* Lamarck.

DONAX RADIANS Lamarck. Plate 12, figs. 4 and 5.

The shell is triangularly egg-shaped and compressed. It is rather thick and inequilateral. The coloring is variable; grayish, whitish pink, sometimes rayed. The shell is concentrically striated. The posterior end is short, and the anterior end is longer and rounded. The interior of the shell is white, yellow, or deep violet.

Length, 16 millimeters; height, 18; breadth, 18.

HEART SHELLS

CARDIIDÆ

Other names.—Edible cockles, sand cockles.
Vernacular names.—Kanturî, butîl (Tag.); kayok (Vis.).

OCCURRENCE, HABITAT, AND HABITS

Members of this family are either marine or brackish-water forms occurring at intertidal zones, in sand or mud, and usually forming extensive beds in quiet bays and estuaries. They are more or less abundant near low water at Parañaque and Cavite.

The heart shells have siphons which are short and fringed at the tip, two gills on each side, and a large, sickle-shaped foot. Naturally, these clams are shallow active burrowers, moving about freely in a jerky and awkward manner. They can thrust the foot to its full extent and with it lift themselves with a twisting motion and come down a distance of a few centimeters. The foot expands at the tip so as to form a fulcrum on which the locomotory muscles act.

UTILIZATION

Undoubtedly several species of heart shells are collected and sold in the market with other clams. The kind known as kanturi appears to be the commonest marketed and is often mistaken for the butil (*Venus squamosa* Linnæus) which it closely resembles in external features and with which it is always associated in the natural habitat. The sand cockles are steamed or boiled in the shell, and the meat, which has a tasty flavor, makes an excellent soup or chowder. They are sold alive at from 3 to 5 centavos a hundred. The empty shells are used in lime making.

DESCRIPTION OF THE SPECIES

The only species encountered in the Manila markets is *Hemidonax donaciforme* Schroeter.

HEMIDONAX DONACIFORME Schroeter. Plate 12, figs. 6 to 8.

The shell is heart-shaped and rather solid. The posterior end is angulated. The exterior is whitish or orange yellow and is blotched on the posterior area. It is radiately grooved; the grooves on the anterior end are less distinct than those on the posterior end.

Length, 32 millimeters; height, 24; breadth, 20.

CYRENAS

CYRENIDÆ

Other names.—Little-neck clams, green clams.

Vernacular names.—For the large clams, lukan, tapalang, kabebe, bebe (Tag.); bebe, tuay, kayug (Vis.); for the small clams, tulya (Tag.); kagaykay (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The Cyrenidæ inhabit the sand or mud bottoms in fresh, salt, and brackish waters. Several forms occur on the tidelands of Manila Bay, in neighboring creeks and rivers, and in Laguna de Bay. These clams are active burrowers; the larger kinds are generally found buried to a depth of about 5 centimeters; the smaller ones are usually met with on or near the surface. They all have a large foot and short siphons but lack that tool for attachment, the byssus. They are bisexual; that is, the organs of both sexes are present in each individual. The young develop internally and are born possessing the external characters of the adult.

The species of *Corbicula*, locally known as tulya, apparently begins to spawn at a small size. Specimens 10 millimeters in length have been found sexually ripe. It is probable that under favorable conditions this species may become sexually mature at even smaller size. The frequency at which the tulya spawns within the twelve months at any given locality is not definitely determined. In all probability it spawns continuously during the year. A fair quantity of tulya of different sizes appears in the Manila markets practically every month of the year. However, during July, August, September, and October the amount marketed is greatest, thus indicating that spawning reaches its maximum during the previous months. The rate of growth of young tulya is comparatively rapid. In Laguna de Bay, it has been observed to increase at an average group rate of 0.18 centimeter in seven months.[8] At present nothing very definite is known about the biology of the larger as well as most of the smaller members of this group.

METHOD OF COLLECTION

The larger forms, coming under the popular name of lukan or tapalang, are collected in water 1 to 3 meters deep by feeling them with the toes or fingers, and on the tide flats by scratching the ground with a tool like an old bolo or a flat piece of iron; the smaller clams, the tulla or tulya, found in creeks, rivers, and lakes are generally gathered by dredging them with especially designed dredge nets or dredge sieves of bamboo splints; and those found in very shallow water or in exposed areas during ebb tide are obtained by sifting the ground with the fingers.

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[8] Villadolid, D. V., and F. G. Rosario, Philip. Agriculturist 19 (1930) 355–382.

UTILIZATION

The lukan and tulya are of considerable economic importance, being used extensively and in large quantities as food for ducks and for man. The clams are simply boiled or steamed, often with slices of ginger root to flavor the resulting broth, and the meats are eaten plain or with vinegar sauce. The shellfish may be shucked and the raw meats prepared with pork, beef, shrimps, and vegetable.

DESCRIPTION OF THE SPECIES

The commonest species sold in the markets are *Cyrena ventricosa* Deshayes and *Corbicula fluminea* Muller. We would have preferred to retain the name of *Corbicula manilensis* Philippi, for the Philippine species of *Corbicula fluminea* Muller as suggested by Prashad of the Indian Museum, but with the very great number of specimens collected we could not justify the retention of the name for geographical reasons alone.

CYRENA VENTRICOSA Deshayes. Plate 14, figs. 1 and 2.

The shell is large and thick. The exterior is pale yellow and is concentrically fringe-striated. The anterior end is short and rounded, and the posterior end is produced and somewhat obtusely angled. The interior of the shell is white.

Length, 64 millimeters; height, 60; breadth, 30.

CORBICULA FLUMINEA Muller. Plate 14, figs. 3 to 8.

The shell is more or less triangular in shape and gibbous. It is high and nearly equilateral. The exterior is covered with a smooth, shining, yellowish brown epidermis. The concentric ridges are strong and far apart. The umboes are raised. The dorsal margin is sloped on each side. The posterior end forms an obscure angle and its epidermis is dull and fringed. The interior of the shell is whitish to bluish white.

Length, 28 millimeters; height, 28; breadth, 18.

FRESH-WATER MUSSELS

UNIONIDÆ

Other names.—Fresh-water clams, river clams, unios.

Vernacular names.—Sulib, paros (Tag.); balisalá, balinday (Vis.); baliharâ (Zam.).

OCCURRENCE, HABITAT, AND HABITS

Fresh-water mussels are found inhabiting the sandy or muddy bottoms of creeks, rivers, and lakes. Laguna de Bay and Pasig River and other rivers near Manila yield a considerable quantity. The clams are usually encountered buried about five centimeters below the surface of the sand or mud, which indicates that the mollusks are shallow burrowers; in fact, they are more or less migratory in habit, moving about freely on the bottom by means of the large foot. Like most bottom dwellers, these clams subsist mainly upon dissolved organic matter and microscopic organisms in their environment. The young hatch from the eggs already provided with shells.

UTILIZATION

Considerable numbers of these river clams, which are collected from Laguna de Bay and Pasig River by simply sifting the sand with the fingers or dredging with some sort of dredge sieve made of bamboo splints, are brought to the public markets in Manila where they are known as paros or sulib and sold for from 15 to 40 centavos a hundred. The mussels are steamed or boiled in the shell, and the cooked meat, which is large and tender, is eaten plain or mixed with vegetables. The empty shells are used in the making of lime.

DESCRIPTION OF THE SPECIES

The commonest unio sold in the markets is *Dalliella subcrassa* Lea.

DALLIELLA SUBCRASSA Lea. Plate 10, figs. 1 and 2.

The shell is subrhomboidal to oblong and is fairly thick. The exterior is dull brown with a greenish or yellowish tint and is smooth. It is concentrically striated. The anterior end is short and rounded; the posterior end is obtusely produced and roundly angular. The dorsal margin is straight, and the ventral margin is slightly contracted at the middle. The umboes are smooth, prominent, and purplish. The interior of the shell is purplish.

Length, 60 millimeters; height, 35; breadth, 21.

STROMBUS SHELLS

STROMBIDÆ

Other names.—Strombs, wing shells, conch shells, "fountain shells," "buzzard mollusks."

Vernacular names.—Balákwit, buláksik, palagsí (Tag.); liswí, sikád (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The Strombidæ found along the shores of Manila Bay are mainly littoral in occurrence. They are active, moving about freely in a peculiar gait by means of the foot, which is narrow in front and arched and broad behind; they are instinctively alert and show power of discrimination which almost approaches intelligence. It has been observed that these conch shells are rather impulsive in temperament and do not glide as most bivalves do but jump along, driving the sharp point of the claw or operculum (that horny plate of cuticle on the hind portion of the foot) into the ground, and flopping the shell from side to side as they progress. When frightened they try to get away by leaps and bounds, making turns to escape capture. If placed on their back they can right themselves by a somersault. Those crawling on rocks are usually noticed moving in a sort of unstable equilibrium, which is due to the fact that the shell is quite heavy for the foot to lift; and at a slight push of the operculum the strombs roll down. In this way they generally get back to the water after being left exposed on the rocks or sloping sand beach by the tide.

These mollusks are believed to feed mainly on flesh, which they tear by means of the well-developed radula, or rasping tongue. Their sense of smell is as keen as their eyesight. On account of their liking for flesh those living among coral rocks may be captured with a bait of meat; but those on the sandy beaches can, of course, be easily gathered by simply picking them up.

UTILIZATION

A fair number of strombus shells appears in the public markets where they are sold fresh in the shell for from 5 to 8 centavos a dozen. They are steamed or boiled in the shell or simply baked over a fire, and the meat is generally removed by pulling it out by the hard cuticle or prying it out with a sharp tool. The flesh has a characteristic taste and when eaten plain gives an after-effect that increases one's craving for drinking water.

The empty shells are utilized in lime making and also as sinkers of fishing nets. To fit them for the last-named purpose, the apex of each shell is broken off, and then the shells are strung at intervals along the ground rope of nets.

DESCRIPTION OF THE SPECIES

The strombs are only occasionally met with in the Manila markets, and the species generally present is *Strombus canarium* Linnæus.

STROMBUS CANARIUM Linnæus. Plate 15, fig. 5.

The shell is shortly egg-shaped, somewhat heart-shaped. It is thick, heavy, and solid. The color is pale brownish or yellowish white, densely, longitudinally marked with alternating brown and white lines. The spire is rather sharp; the whorls are smooth and gibbous and linearly grooved towards the apex. The columella is very callous. The lip is winged and thickened. The aperture is white.

Length, 56 millimeters.

MELONGENAS

BUCCINIDÆ

Other names.—Whelk, conch.

Vernacular names.—Kalaunghuga (Tag.); kahángkaháng, alánalán (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The melongenas, which belong to a large and aggressive family of carnivorous mollusks, have been found on the shores of Manila Bay, particularly at Malabon, Navotas, Parañaque, Binakayan, and Kawit. They occur singly and prefer to live in brackish water and among clams and the nonresistant oysters. It is not uncommon to observe a number of melongenas surrounding some oysters, watching until the latter let their shells gape when the gastropods all thrust in their long and tough snouts; when the muscle of the oyster is reached the radula or rasping tongues of the aggressors soon overpower the prey.

UTILIZATION

The melongenas are used for food and marketed in the shell in the local markets where they bring from 5 to 10 centavos a dozen. The gastropods are steamed or boiled or simply placed over a fire until the animal is cooked when it is extracted by prying it out or breaking the shell. The boiled or steamed meat is eaten plain or with some sauce or cooked with a vegetable. The empty shells are utilized in lime making.

DESCRIPTION OF THE SPECIES

Melongena pugilina Born and *Melongena galeodes* Lamarck are the two common species encountered. The first is very popular and eagerly sought, while the second does not have much demand.

MELONGENA PUGILINA Born. Plate 16, figs. 1 and 2.

The shell is somewhat mango-shaped, inflated, and thick. It is yellowish brown or dark brown, and is covered with hairy somewhat velvety epidermis. The whorls are spirally ridged towards the apex and are tubercled. The aperture is orange yellow.

Length, 88 millimeters.

MELONGENA GALEODES Lamarck. Plate 16, figs. 3 and 4.

The shell is smaller than that of *M. pugilina* Born. It is pale brown, whitish, or cream color. The spines are rather sharp, and the whorls are generally frilled or scaly and full of spines at the sutural line. The shoulder is provided with spines or nodules and below it is another row of spines. The aperture is white.

Length, 50 to 55 millimeters.

HORN SHELLS

CERITHIIDÆ

Vernacular names.—Susô, susóng dagat, susóng putî, bayoñgon, bañgoñgon (Tag.); susô, awis, bagoñgon (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The horn shells live in brackish and fresh water on rocks or among marine vegetation. There are some which are able to live for long periods out of water, attaching themselves to trunks and stems of marsh plants by means of mucus that affixes the lip to the objects in their habitat. They are primarily littoral in distribution, inhabiting the muddy ground of swamps, estuaries, and fishponds. Around Manila Bay incredible numbers of the smaller kinds are found on the tide flats, buried, exposed, or entangled among algæ and other water plants. A considerable quantity of the larger forms can also be found in similar surroundings; these, however, occur singly and are more or less active, crawling on the ground by means of the large foot.

These mollusks subsist mainly upon algæ and diatoms, which are abundant in their natural habitat. They are apparently very prolific. Facts about their spawning season and the frequency at which they reproduce at a given locality within a given time and their rate of growth are not definitely known.

UTILIZATION

The horn shells are all edible and are extensively used as food in the Philippines. The smaller kinds, which are collected in quantity by simply raking them in, are utilized more for lime making, while the larger species are gathered primarily for human consumption. Both kinds when consumed for food are steamed or boiled; the apex of each shell is broken off and then the flesh is sucked out through the large opening. The meat has a piquant taste which increases the desire for frequent drinking of water. In the public markets the smaller shells, known as susô, sell at 5 centavos per kilogram; the larger kinds, or bañgoñgon, at about 10 centavos per kilogram.

DESCRIPTION OF THE SPECIES

The three species that have been identified in the lot of specimens generally offered for sale in the markets are *Potamides (Telescopium) telescopium* Linnæus, *Potamides (Cerithidea) rhizoporarum* A. Adams, and *Potamides (Terebralia) sulcatus* Born. The most important species, however, is *Potamides (Telescopium) telescopium* Linnæus.

POTAMIDES (TELESCOPIUM) TELESCOPIUM Linnæus. Plate 15, fig. 1.

The shell is cone-shaped and dark brown. The whorls are numerous and on them are winding narrow channels which divide broader, flat-topped ridges. The base is strongly ridged, and the columella is spirally twisted. The outer lip is expanded and is produced beneath.

Length, 90 millimeters.

POTAMIDES (CERITHIDEA) RHIZOPORARUM A. Adams. Plate 15, fig. 4.

The shell is cylindrical, rather solid, and brown. The whorls are provided with numerous rounded ribs cut into nodules by spiral ridges. The aperture is rounded and notched at the base of the columella. The outer lip is expanded, and the apex is sometimes worn away.

Length, 30 millimeters.

POTAMIDES (TEREBRALIA) SULCATUS Born. Plate 15, figs. 2 and 3.

The shell is subpyramidal, somewhat swollen, and brown. The whorls are longitudinally and strongly ribbed and are tuberculated by the crossing of incised spiral grooves. The aperture is mango-shaped. The outer lip is expanded, bent around, and joined with the inner lip, crossing and partially closing the anterior canal.

Length, 50 millimeters.

WHEEL SHELLS

UMBONIDÆ

Vernacular names.—Kaligay (Tag.); batad (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The members of this family are small mollusks inhabiting sandy shores of bays and open seacoasts. A few forms have been encountered in Manila Bay. Apparently the sandy beaches of Pasay and Parañaque are the most favorable grounds for kaligay, as practically all that enter the public markets come from these localities where they occur in beds or scattered groups.

Where the sand is covered with a few centimeters of water the kaligay may be seen gliding along on the bottom; on the moist exposed sandy beaches they may also be noticed moving slightly under the surface; it is not uncommon to find them completely covered; but generally they leave characteristic tracks, which when traced betray their location. Being small the wheel shells are at the mercy of the elements; and but for the flatness of their shell and their ability to right themselves, they would not survive in such an unstable surrounding, which is always being shifted by the waves and currents. It is interesting to note that the kaligay are rarely seen upturned unless dead. The foot is apparently a very effective organ not only for locomotion but for anchorage as well.

UTILIZATION

The kaligay, although small, are nevertheless of some economic importance due to their abundance and the facility with which they are gathered in quantities, and to the characteristic flavor of the meat which is relished by Filipinos. In Pasay and Parañaque great numbers are collected by simply sifting the sand with the fingers. Sackfuls are brought to the local markets, where they are sold for 5 centavos a kilogram. The kaligay are marketed cooked; they are steamed or boiled much as clams are steamed in the shell. Since the flesh is small and quite difficult to extract, the vendor gives the buyers thorns of aroma, *Acacia pennata* (Linn.) Willd., with which to pry the meat out. However, a pin is just as effective a tool to remove the snail. Kaligay eating is indulged in as an after-meal pastime.

DESCRIPTION OF THE SPECIES

The only species encountered in the markets and among the street vendors is *Umbonium vestiarium* Linnæus.

UMBONIUM VESTIARIUM Linnæus. Plate 11, figs. 6 to 10.

The shell is small and depressed, thin but strong. It is shining, polished, and smooth. The colors are variable, and the combinations present striking patterns. The whorls, numbering about six, are rounded at the periphery. The callus pad is large, polished, and convex. The aperture is somewhat heart-shaped and is iridescent within.

Altitude, 10 millimeters; diameter, 15.

All the more usual color patterns known have been encountered, but the more numerous are those finely mottled above, the base white or plain colored, the peripheral zone the same as the general pattern, or with large radiating spots, or a white-edged girdle of red.

FRESH-WATER SNAILS

PILIDÆ, OR AMPULLARIIDÆ

Other names.—River snails, pond snails, marsh snails, apple snails, flask snails, ampullarias.

Vernacular names.—Kohol, egue, susóng bilog, susóng pangpang, susóng tabang (Tag.); kool, ege, agos-os (Vis.); betocol (Zam.); bisocol (Il.).

OCCURRENCE, HABITAT, AND HABITS

The Pilidæ, or Ampullariidæ, are an amphibious family of mollusks which are represented by a number of species occurring abundantly in fresh-water ponds and marshes, creeks, and paddy fields. In Laguna de Bay and Pasig River and near-by streams at least three species are found in large quantities, living on sandy bottoms in shallow water and among water plants and submerged objects upon which they crawl about in a gliding movement by means of the broad flat foot.

The snails are at home in and out of the water by virtue of the peculiar character of the gills, which lie in a large, partially closed, breathing chamber. In time of drought they retreat under the mud and live there for months in a state of suspended animation (æstivation). Indeed, these pond snails survive removal from the water for remarkably long periods, breathing air but all the while keeping the breathing cavity moist. In habit they are gregarious and strictly vegetarian, subsisting upon the roots, leaves, and stems of aquatic plants.

In Pilidæ, or Ampullariidæ, the sexes are separate; that is, the individual is either male or female. According to a recent investigation[9] one species, *Pila luzonica* Reeve, found in Laguna de Bay, has been observed to attain sexual maturity at the age of about 6 months when the male has an average length of 27.61 millimeters and the female 29.12 millimeters. In places where there is always water this species has been found to spawn continuously throughout the year; it deposits its eggs on roots, stems, and leaves of aquatic plants and on the sides of dikes of rice fields and irrigation ditches; the eggs are nearly always laid on objects at water level since when submerged in water they do not hatch.

METHOD OF COLLECTION

The snails living in groups on the sandy bottom are readily collected by a sort of long-handled scraper, the pañgahig (fig. 6), or dredge net, operated from a banca. The snails clinging to water plants and dikes are simply gathered by hand.

UTILIZATION

Although more commonly regarded as poultry feed than as food for man, kohol are also eaten extensively by poor people. It has been estimated that no less than 15,000 liters of kohol are used daily in the poultry industry at the southwestern shores of Laguna de Bay, and a considerable quantity is utilized as food by the inhabitants of Laguna Province, besides the fairly large amounts brought to the public markets in Manila where they are sold as human food for from 4 to 10 centavos a hundred. The snails are cooked in the shell in combination with a species of edible fern, pakó, *Athyrium esculentum* Copeland, or with gábi, *Colocasia esculentum* (Linnæus) Schott, and coconut milk. The flesh is sucked out through the opening after the peak or tip of each shell has been broken off to facilitate sucking. The raw meat is also utilized to some extent as bait for line fishing.

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[9] Nono, A. M., and A. M. Mane, Philip. Agriculturist 19 (1931) 675–695.

DESCRIPTION OF THE SPECIES

The commonest and most important of these snails is *Pila luzonica* Reeve.

PILA LUZONICA Reeve. Plate 17, figs. 4 to 6.

Ampullaria luzonica REEVE.

The shell is shaped somewhat like a swollen globe. It is reddish yellow or reddish brown, thin, smooth, and at times shining. The whorls are flatly impressed around the upper part, then rounded. They are densely, finely, and longitudinally striated, also obscurely banded. The aperture is egg-shaped and rather large.

Altitude, 40 millimeters; diameter, 36.

FRESH-WATER SNAILS

VIVIPARIDÆ

Other names.—Pond snails, river snails, viviparas.

Vernacular names.—Kohol, egue, susô, susóng pangpang (Tag.); ege (Vis.); bisocól (Il.); betocol (Zam.).

OCCURRENCE, HABITAT, AND HABITS

The Viviparidæ are found in fresh and brackish water. In Laguna de Bay and its tributaries several species of viviparas have been found to occur more or less abundantly on sandy or muddy bottoms in shallow water and among water plants and submerged objects. Like the ampullarias, they are active and gregarious; they crawl about by means of the broad flat foot and feed on growing and decaying algæ and other decaying vegetable matter, and dissolved organic material or detritus formed on the surface of the muddy bottom.

The viviparas are self fertilizing live-bearing mollusks; they are hermaphroditic; that is, both reproductive organs are present in each individual, and they produce eggs that are incubated and hatched within the parent's body. The young are born already possessing all the external characters of the adult.

In a recent study on the biology of *Vivipara angularis* Muller[10] (*Vivipara burroughiana* Lea) it has been observed that this species becomes sexually mature at the age of about 2 months when it attains an average length of 19.09 millimeters and an average width of 15.4 millimeters.

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[10] Alonte, F. H., Philip. Agriculturist 19 (1930) 307–325.

Generally the viviparas are most abundant in Pasig River and Laguna de Bay from January to April, which indicates that the height of the spawning season in the region is during the previous months.

METHOD OF COLLECTION

The viviparas are collected in quantity in the same manner as the ampullarias. Those on the beds of lakes, rivers, and creeks are dredged by various sorts of dredge nets operated from bancas; those clinging to aquatic plants and submerged objects like the *bonbon*, which consists of bundles of switches placed in the water for catching shrimps, are picked by hand.

UTILIZATION

These snails are the most valued for duck feed; they are to some extent used as food by the inhabitants around Laguna de Bay and in Manila and vicinity. The snails are prepared for the table in the same manner as the ampullarias. In the public markets in Manila they sell for about 6 centavos a hundred.

DESCRIPTION OF THE SPECIES

Apparently the only species gathered and sold for food is *Vivipara burroughiana* Lea.

VIVIPARA BURROUGHIANA Lea. Plate 17, figs. 7 and 8.

The shell is elevately conical and green to greenish brown. It is delicately formed and rather thin. The whorls are more or less sharply angled at the upper part and spirally corded with fine ribs. The ribs are generally three, sometimes more, and there are other finer ridges between them. Both ribs and ridges are crossed by strong striations.

Altitude, 33 millimeters; diameter, 23.

FRESH-WATER HORN SHELLS

THIARIIDÆ, OR MELANIIDÆ

Other names.—Melanias, black snails, marsh snails.

Vernacular names.—Susô, susóng buele, sambuele, susóng tabang, susóng pilipit, bilibid (Tag.); banág, susô, awis (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The Melaniidæ, represented by numerous species, inhabit shallow creeks and ponds, swift streams and rapids. In Pasig River and Laguna de Bay at least four species are known to occur very abundantly.

The melanias are active and strong, carrying around their turreted shells with remarkable ease; they are not strictly gregarious so that in their natural habitat they are met with either singly or in scattered groups of a few individuals. They feed on algæ and other aquatic plants. The melanias are very prolific and generally bring forth the young already possessing all the external characters of the adult.

UTILIZATION

Like the ampullarias and viviparas, these fresh-water black horn shells, gathered from Laguna de Bay and the streams around it, are extensively used as poultry feed, particularly by duck raisers; they are also utilized as food for man. In the public markets in Manila they sell at from 10 to 20 centavos a hundred.

DESCRIPTION OF THE SPECIES

The largest of the species and the one sold in the markets for human consumption is *Thiara asperata* Lamarck.

THIARA ASPERATA Lamarck. Plate 17, figs. 1 to 3.

Melania asperata LAMARCK.

The shell is generally eroded towards the apex. It is reddish brown to dark brown and more or less solid. The whorls, numbering twelve or more, are longitudinally and plicately ribbed. They are also transversely and spirally ridged. The aperture is subcircular, and the inner lip is somewhat callous.

Altitude, 60 millimeters; diameter, 18.

TONGUE CLAMS

LINGULIDÆ

Other names.—Lamp shells, lingulas, brachiopods.

Vernacular names.—Bálay (Tag.); úgpan (Vis.).

OCCURRENCE, HABITAT, AND HABITS

The Lingulidæ are well represented in the Philippines by *Lingula unguis* Linnæus. In Manila Bay this species, locally known as bálay, occurs in large numbers, living in vertical burrows in shallow water along the shores of Pasay, Malabon, Puerto Rivas, and Balanga.

In the natural habitat the bálay is generally found with the stalk buried and the shell partly exposed above the surface. On grounds with clear shallow water and in pools left by the receding tide, it is usually seen partly out of its burrow, with the valves gaping and the setæ vibrating in unison, thus producing a sort of channel as the water flows in and out in definite currents. The animal is breathing and feeding simultaneously in this manner.

The bálay is sensitive to disturbance; its peduncle or stalk is capable of withdrawing the shell suddenly whenever alarmed, leaving a slitlike hole in the ground; this aperture betrays the presence of the animal and experienced diggers can detect it from a fair distance and take advantage of this fact when collecting the shellfish.

The bálay is an active digger and its burrowing methods are interesting. It may dig on its side using the stiff hairs to plow into the sand while forcing the body forward; it may penetrate the ground by means of the peduncle, in the manner of a worm, dragging the body down as it cleaves the sand; or, it may bury itself head first, a method usually exhibited by an individual with the peduncle broken close to the body.

In all probability the bálay spawns throughout the year in Manila Bay. During June and July particularly great quantities appear in the public markets in Manila, which indicates that possibly the height of the spawning period is during the previous months.

UTILIZATION

The bálay is extensively used as food, especially by the people living near the grounds. Considerable quantities are brought into the public markets where they sell for about 15 centavos a hundred. The stalk is generally eaten fresh or pickled in vinegar.

DESCRIPTION OF THE SPECIES

The specific name *anatina* has long been in use for this species, but we agree with Dall [11] that *unguis* has priority and therefore use it here.

LINGULA UNGUIS Linnæus. Plate 17, figs. 9 and 10.

The shell is thin and horny. It is oblong-shaped with the sides nearly straight and subparallel, contracting about the edges in drying. The anterior end is rounded, the posterior is attenuated, and the beak is sharply acuminated. The valves are slightly convex, most convex at the middle, but somewhat flattened laterally. They are closed on each side but slightly gaping at the beak. The surface is smooth with fine concentric lines and radial striæ. There are obscure carinæ, particularly at the median line, extending from the beak to the anterior end. The color is various shades of green, somewhat brownish near the beak.

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[11] Proc. U. S. Nat. Mus. 57 (1920) 262.

The interior is sometimes whitish. The ventral valve is somewhat larger. Its beak tapers acutely to a point and has a channel in the middle to which the peduncle is attached. The dorsal valve is somewhat shorter. Its beak is obtusely rounded with a thickened hinge margin. At the center is a raised elongated ridge.

Length of shell, 45 millimeters; greatest diameter, 20; length of peduncle, 80.

ILLUSTRATIONS

PLATE 1

FIGS. 1 and 2. *Ostrea iredalei* Faustino, interior of lower or left valve.
3 and 4. *Ostrea malabonensis* Faustino, exterior of lower valve.
FIG. 5. *Ostrea malabonensis* Faustino, interior of upper valve.
6. *Ostrea malabonensis* Faustino, interior of lower valve.

PLATE 2

FIGS. 1 and 2. *Ostrea iredalei* Faustino, interior of upper valve.
FIG. 3. *Ostrea iredalei* Faustino, exterior of upper valve.

PLATE 3

FIG. 1. *Ostrea palmipes* Sowerby, interior of lower valve.
2. *Ostrea palmipes* Sowerby, interior of upper valve.
3. *Ostrea palmipes* Sowerby, exterior of lower valve.
4. *Ostrea malabonensis* Faustino, interior of upper valve.
5. *Paphia hiantina* Lamarck, exterior of right valve.
6. *Paphia hiantina* Lamarck, interior of left valve.

PLATE 4

FIG. 1. *Paphia hiantina* Lamarck, exterior of left valve.
2. *Paphia ferruginea* Reeve, exterior of left valve.
3. *Paphia ferruginea* Reeve, interior of left valve.
4. *Paphia hiantina* Lamarck, interior of right valve.
5. *Paphia hiantina* Lamarck, exterior of right valve.
6. *Paphia striata* Chemnitz, interior of right valve.
7. *Paphia striata* Chemnitz, exterior of left valve.
8. *Paphia turgida* Lamarck, interior of right valve.
9. *Paphia turgida* Lamarck, exterior of left valve.

PLATE 5

FIG. 1. *Circe gibba* Lamarck, exterior of left valve.
2. *Circe gibba* Lamarck, interior of left valve.
3. *Circe pectinata* Linnæus, exterior of left valve.
4. *Circe pectinata* Linnæus, interior of left valve.
5. *Circe divaricata* Chemnitz, exterior of right valve.
6. *Circe divaricata* Chemnitz, interior of left valve.
7. *Circe gibba* Lamarck, exterior of right valve.
8. *Circe pectinata* Linnæus, exterior of right valve.

PLATE 6

FIG. 1. *Circe scripta* Linnæus, exterior of right valve.
2. *Circe scripta* Linnæus, interior of left valve.
3. *Venus (Anaitis) alta* Sowerby, jr., interior of left valve.
4. *Venus (Anaitis) alta* Sowerby, jr., interior of left valve.
5. *Venus (Anomalocardia) squamosa* Linnæus, interior of left valve.
6. *Venus (Anomalocardia) squamosa* Linnæus, exterior of right valve.
7. *Mactra mera* Deshayes, interior of left valve.
8. *Mactra mera* Deshayes, exterior of right valve.

PLATE 7

FIG. 1. *Arca antiquata* Linnæus, interior of left valve.
2. *Arca antiquata* Linnæus, exterior of right valve.
3. *Arca binakayanensis* Faustino, interior of left valve.
4. *Arca binakayanensis* Faustino, exterior of right valve.
5. *Arca cepoides* Reeve, interior of left valve.
6. *Arca cepoides* Reeve, exterior of right valve.
7. *Arca antiquata* Linnæus, interior of right valve.

PLATE 8

FIG. 1. *Arca chalcanthum* Reeve, interior of left valve.
2. *Arca chalcanthum* Reeve, exterior of right valve.
3. *Arca cornea* Reeve, exterior of left valve.
4. *Arca cornea* Reeve, interior of right valve.
5. *Arca inæquivalvis* Bruguière, interior of left valve.
6. *Arca inæquivalvis* Bruguière, exterior of left valve.

PLATE 9

FIG. 1. *Macoma pellucida* Philippi, interior of left valve.
2. *Macoma pellucida* Philippi, exterior of right valve.
3. *Soletellina (Soletellina) cumingiana* Deshayes, interior of right valve.
4. *Soletellina (Soletellina) cumingiana* Deshayes, exterior of left valve.
5. *Soletellina (Soletellina) cumingiana* Deshayes, interior of left valve.
6. *Soletellina (Psammotæa) minor* Deshayes, interior of left valve.
7. *Soletellina (Psammotæa) minor* Deshayes, exterior of right valve.

PLATE 10

FIG. 1. *Dalliella subcrassa* Lea, interior of right valve.
2. *Dalliella subcrassa* Lea, exterior of left valve.
3. *Modiolus philippinarum* Hanley, interior of left valve.
4. *Soletellina (Psammotæa) elongata* Lamarck, interior of left valve.
5. *Soletellina (Psammotæa) elongata* Lamarck, exterior of right valve.

PLATE 11

FIG. 1. *Mytilus smaragdinus* Chemnitz, exterior of left valve.
2. *Modiolus metcalfei* Hanley, interior of left valve.
3. *Modiolus metcalfei* Hanley, exterior of right valve.
4. *Modiolus philippinarum* Hanley, exterior of left valve.
5. *Pharella acutidens* Broderip and Sowerby, exterior of left valve.
FIGS. 6 to 10. *Umbonium vestiarium* Linnæus.

PLATE 12

FIG. 1. *Pharella acutidens* Broderip and Sowerby, interior of left valve.
2. *Anatina truncata* Lamarck, interior of left valve.
3. *Anatina truncata* Lamarck, exterior of left valve.
4. *Donax radians* Lamarck, interior of left valve.
5. *Donax radians* Lamarck, exterior of right valve.
6. *Hemidonax donaciforme* Schroeter, interior of left valve.
7. *Hemidonax donaciforme* Schroeter, exterior of right valve.
8. *Hemidonax donaciforme* Schroeter, exterior of left valve.

PLATE 13

FIG. 1. *Mytilus smaragdinus* Chemnitz, interior of left valve.
FIGS. 2 and 3. *Mytilus smaragdinus* Chemnitz, interior of right valve.

PLATE 14

FIG. 1. *Cyrena ventricosa* Deshayes, interior of left valve.
2. *Cyrena ventricosa* Deshayes, exterior of right valve.
3. *Corbicula fluminea* Müller, interior of right valve.
4. *Corbicula fluminea* Müller, interior of left valve.
5. *Corbicula fluminea* Müller, exterior of right valve.
6. *Corbicula fluminea* Müller, exterior of right valve.
7. *Corbicula fluminea* Müller, interior of right valve.
8. *Corbicula fluminea* Müller, interior of left valve.

PLATE 15

FIG. 1. *Potamides (Telescopium) telescopium* Linnæus.
FIGS. 2 and 3. *Potamides (Terebralia) sulcatus* Born.
FIG. 4. *Potamides (Cerithidea) rhizoporarum* A. Adams.
5. *Strombus canarium* Linnæus.

PLATE 16

FIGS. 1 and 2. *Melongena pugilina* Born.
3 and 4. *Melongena galeodes* Lamarck.

PLATE 17

FIGS. 1 to 3. *Thiara asperata* Lamarck.
4 to 6. *Pila luzonica* Reeve.
7 and 8. *Vivipara burroughiana* Lea.
FIG. 9. *Lingula unguis* Linnæus, interior.
10. *Lingula unguis* Linnæus, exterior.
11. *Lingula unguis* Linnæus, with peduncle, or stalk.

PLATE 18

FIG. 1. Piles of oysters, Malabon, Rizal. The larger pile, in the background, consists of dead shells; the smaller pile, in the foreground, contains live oysters.

2. Scattering dead oyster shells to catch oyster spat, Malabon, Rizal.

TEXT FIGURES

FIG. 1. *Meretrix meretrix* Linnæus, left valve; *A*, anterior end; *P*, posterior end; *D*, dorsal margin; *V*, ventral margin; *AP*, length of shell; *VD*, height of shell; *h*, ligament, or hinge line; *u*, beak, or umbo; *c*, hinge, or cardinal, teeth; *l*, lateral tooth; *am*, anterior adductor muscle scar; *pm*, posterior adductor muscle scar; *pl*, pallial line; *ps*, pallial sinus.

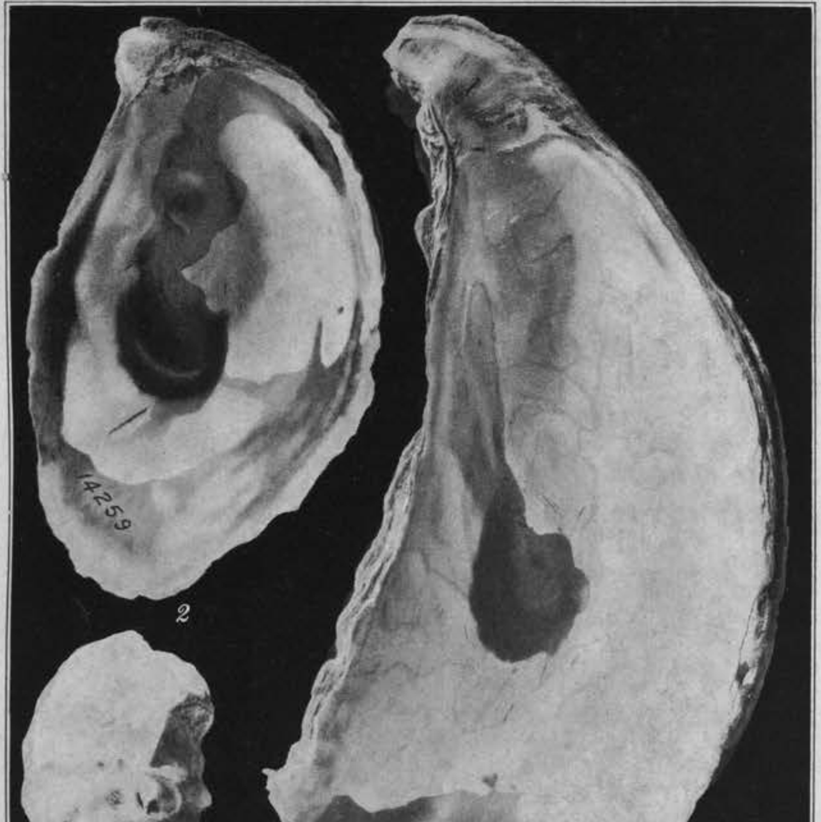
2. *Meretrix meretrix* Linnæus, right valve; lettering the same as in fig. 1.

3. *Meretrix meretrix* Linnæus; *b*, breadth; *lu*, lunule; *u*, umbo; *l*, ligament area.

4. *Murex torrefactus* Sowerby, young; *a*, apex; *s*, spire; *m*, mouth, or aperture; *o*, outer lip; *ac*, anterior canal; *co*, columella; *va*, varix; *su*, suture; *b*, body whorl; *sb*, shoulder of whorl.

5. The kulakud.

6. The pañgahig; *h*, handle, *s*, iron nails; *w*, wire netting.



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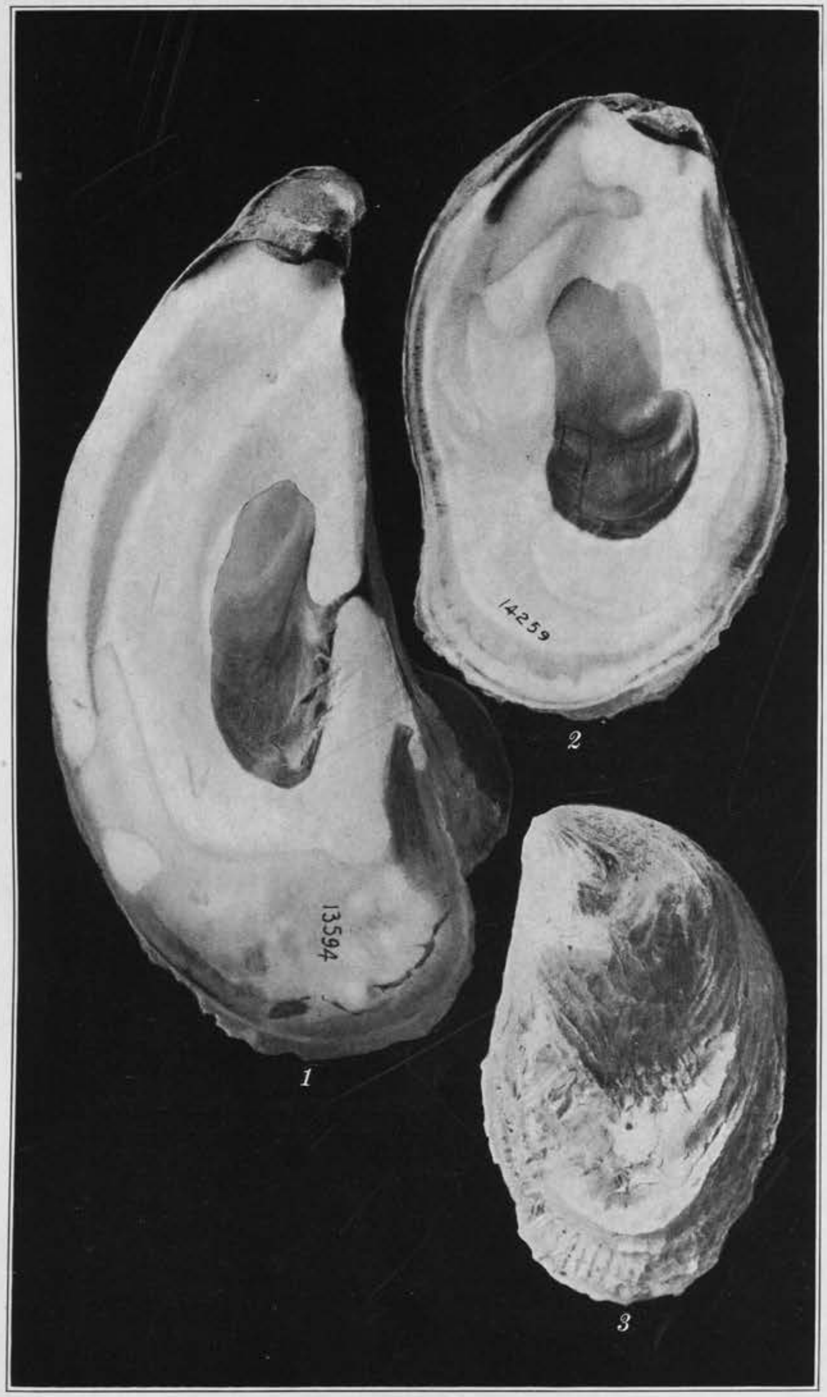

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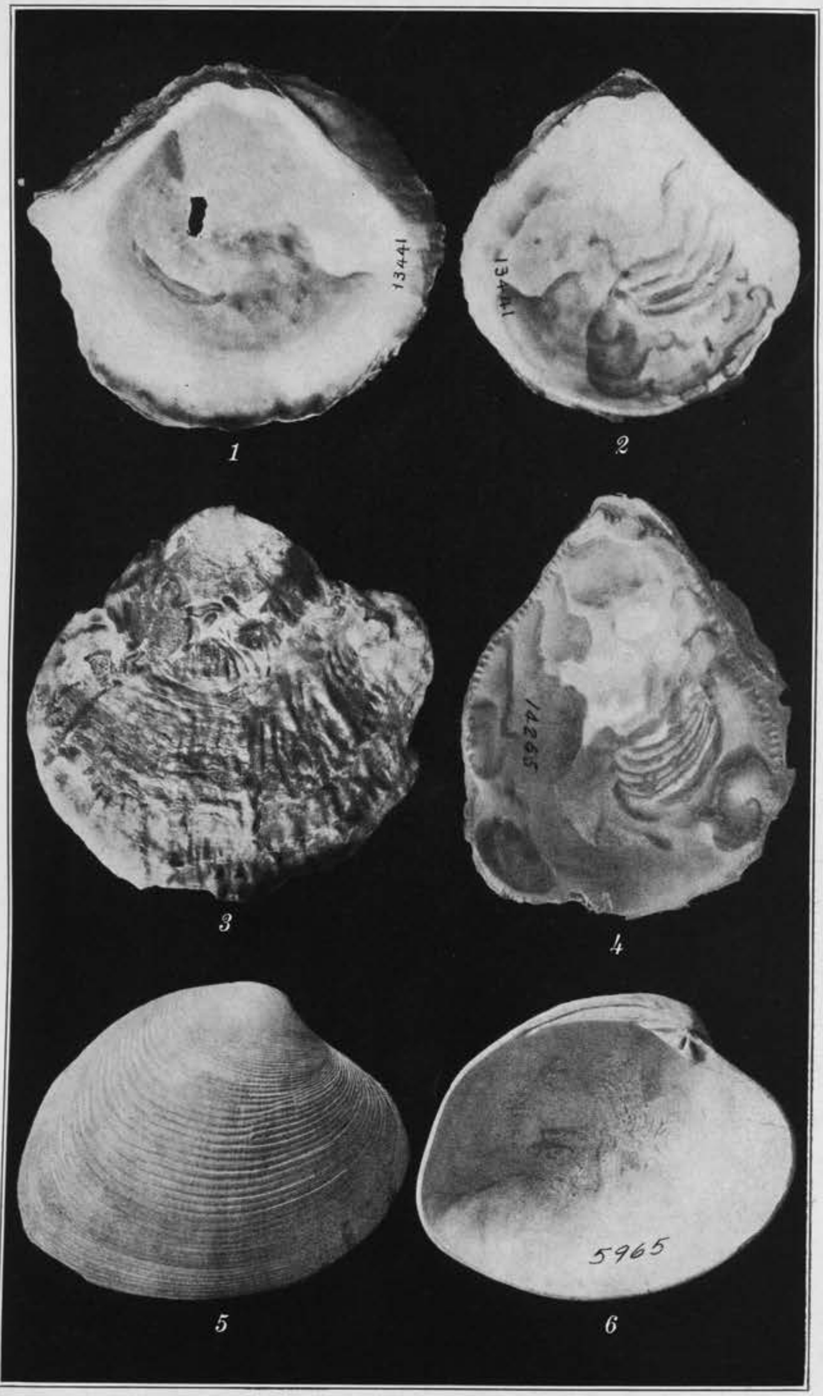

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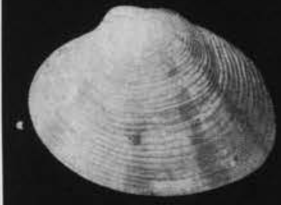
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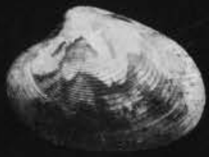
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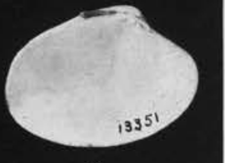

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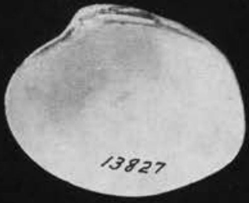

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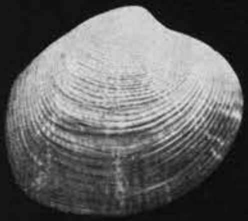
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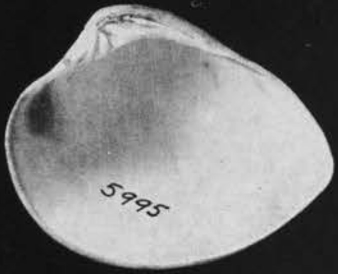

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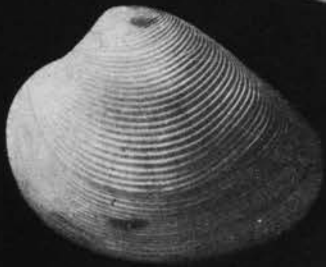
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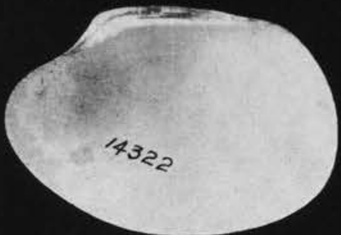

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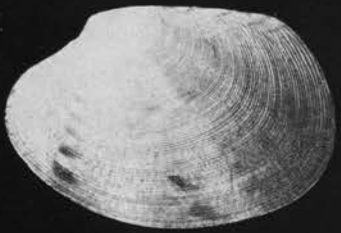
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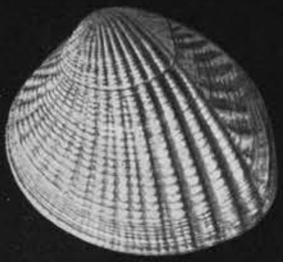

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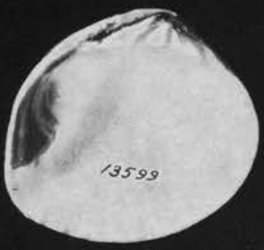

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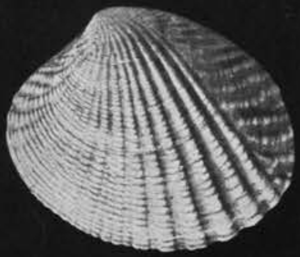

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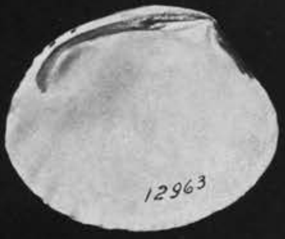

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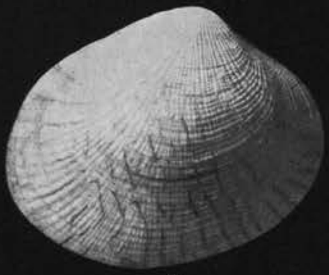

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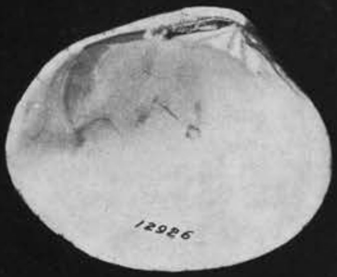

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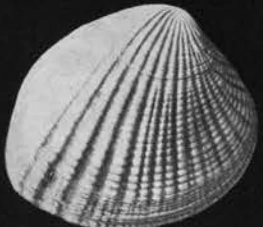

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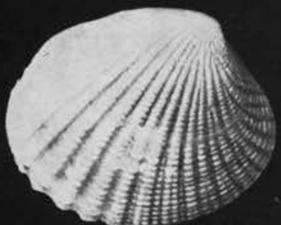

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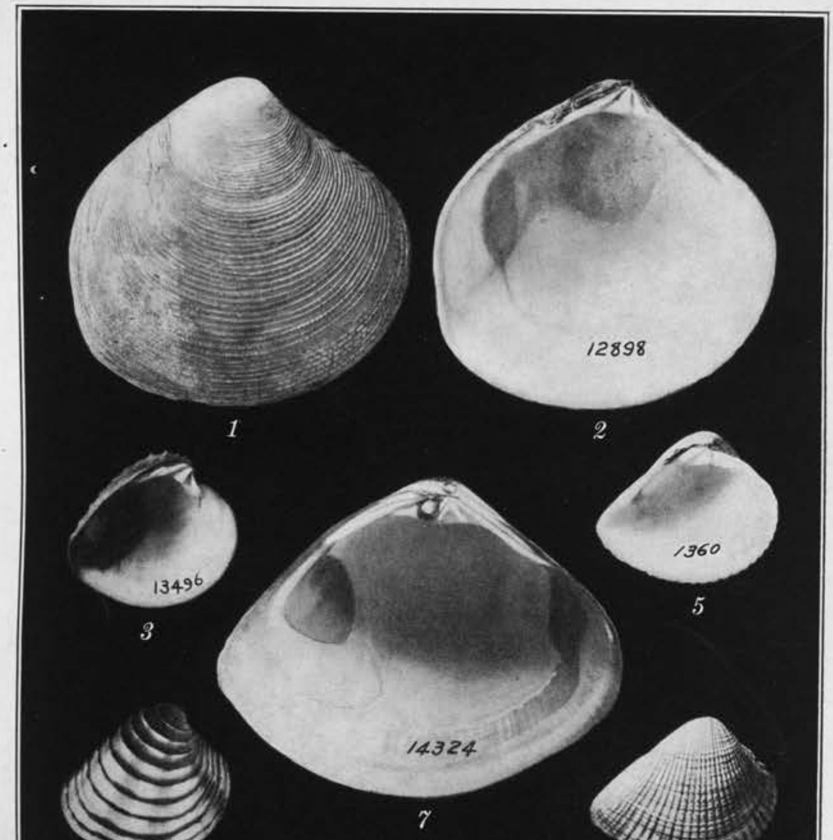

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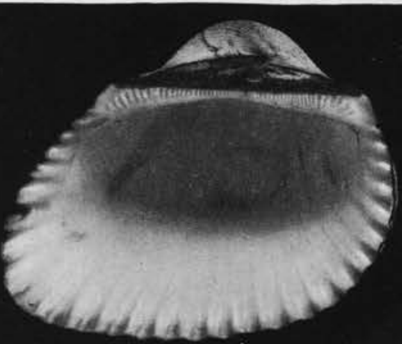

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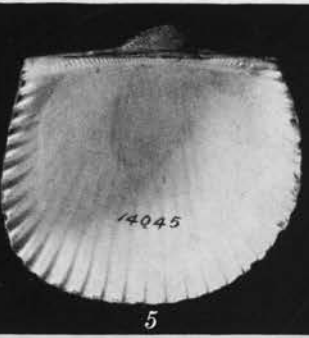

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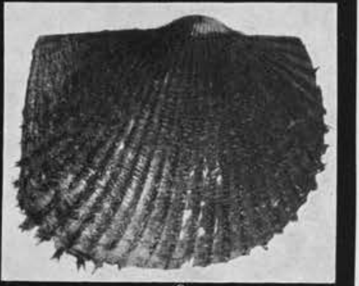

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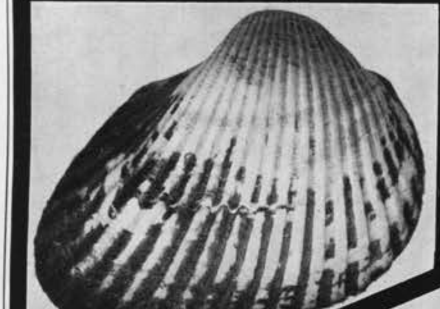

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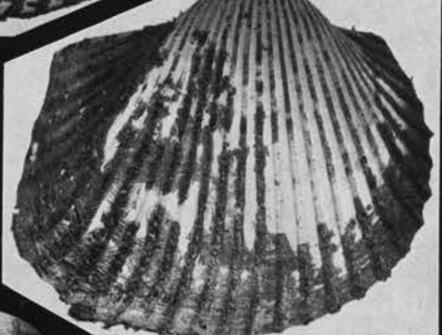

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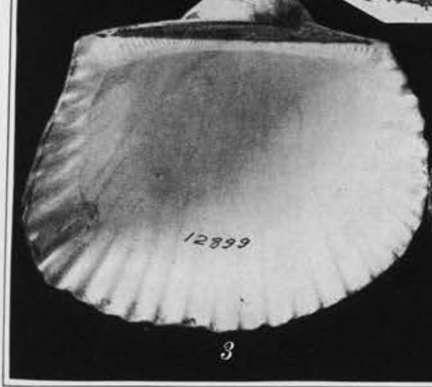

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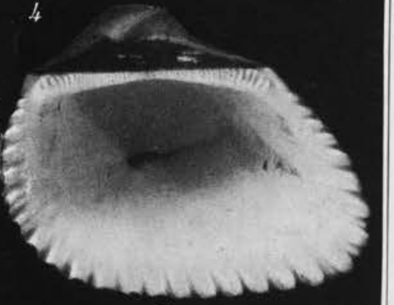

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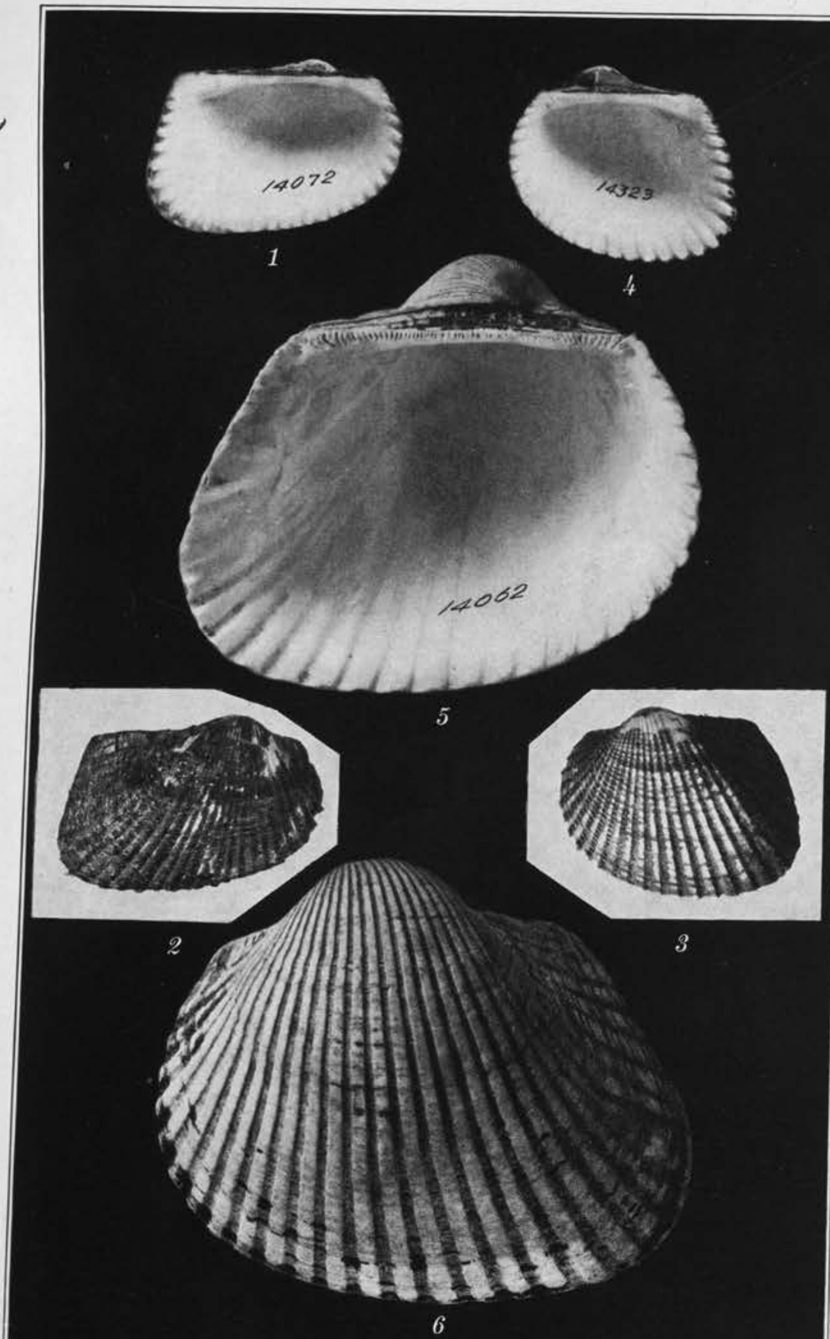

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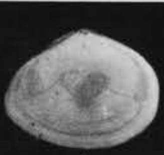

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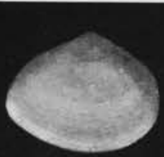

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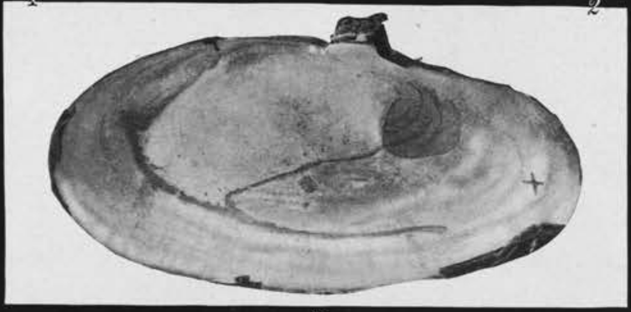

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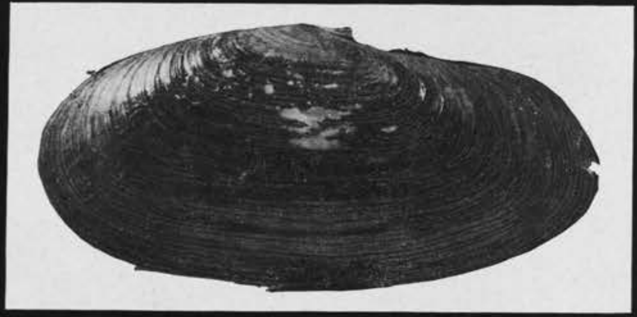

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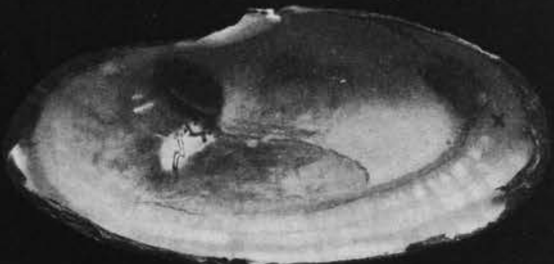

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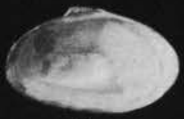

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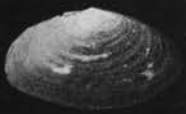

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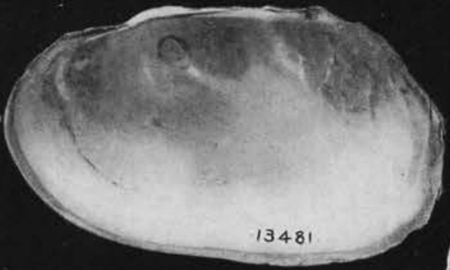

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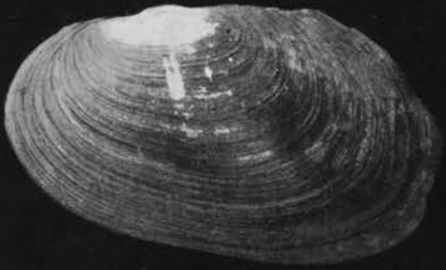

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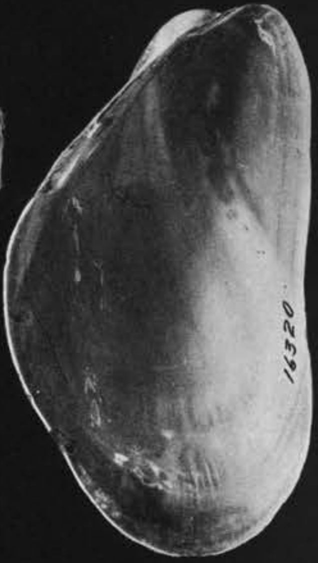

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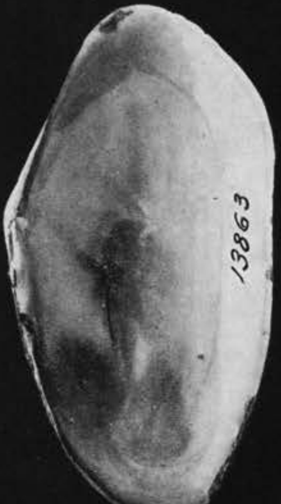

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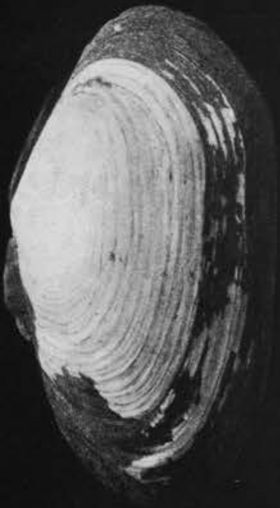

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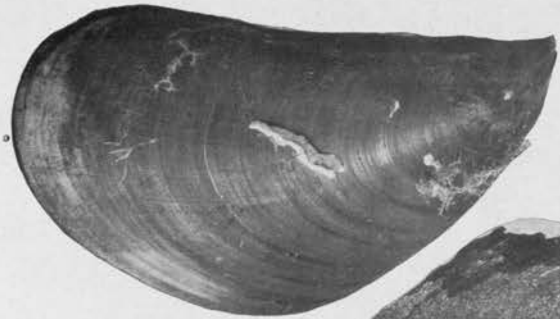

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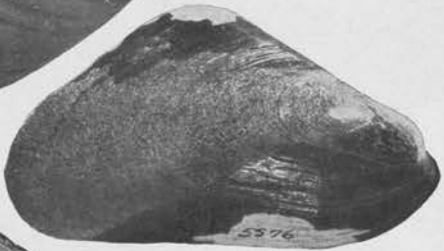

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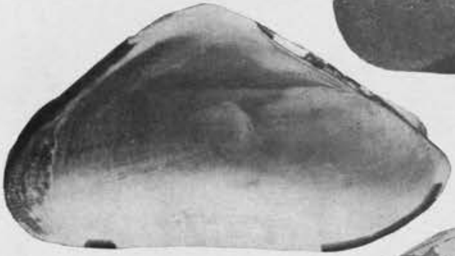

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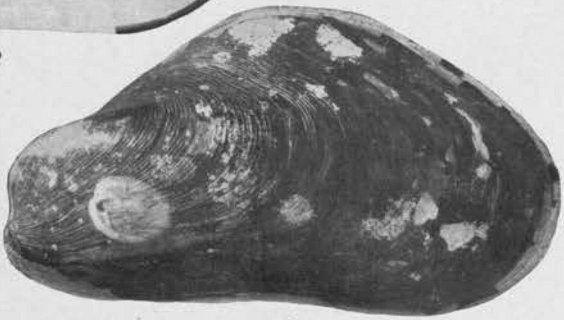

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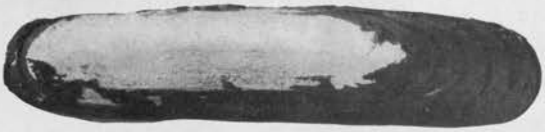

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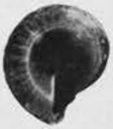

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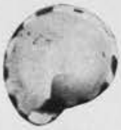

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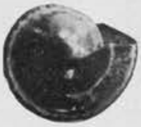

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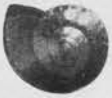

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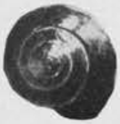

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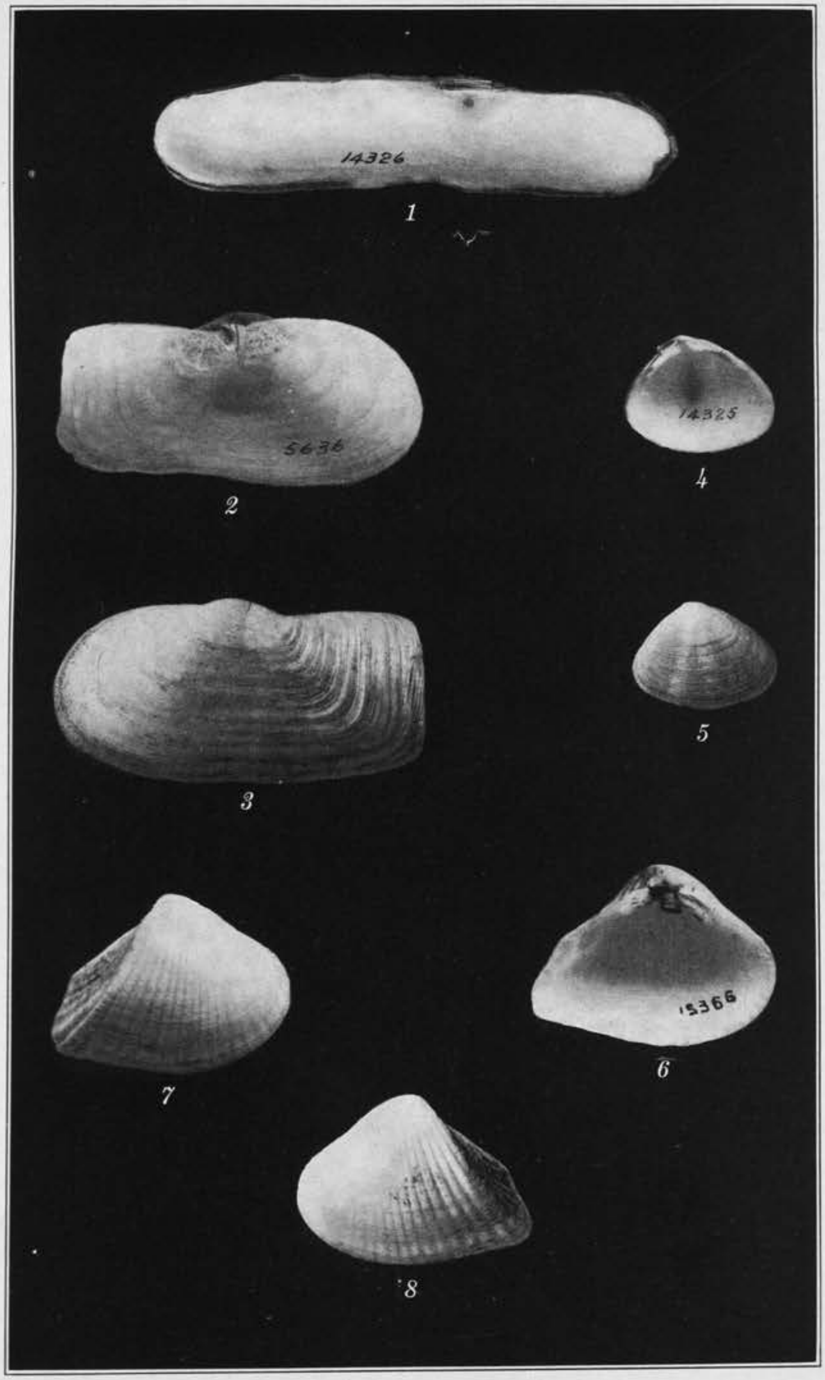

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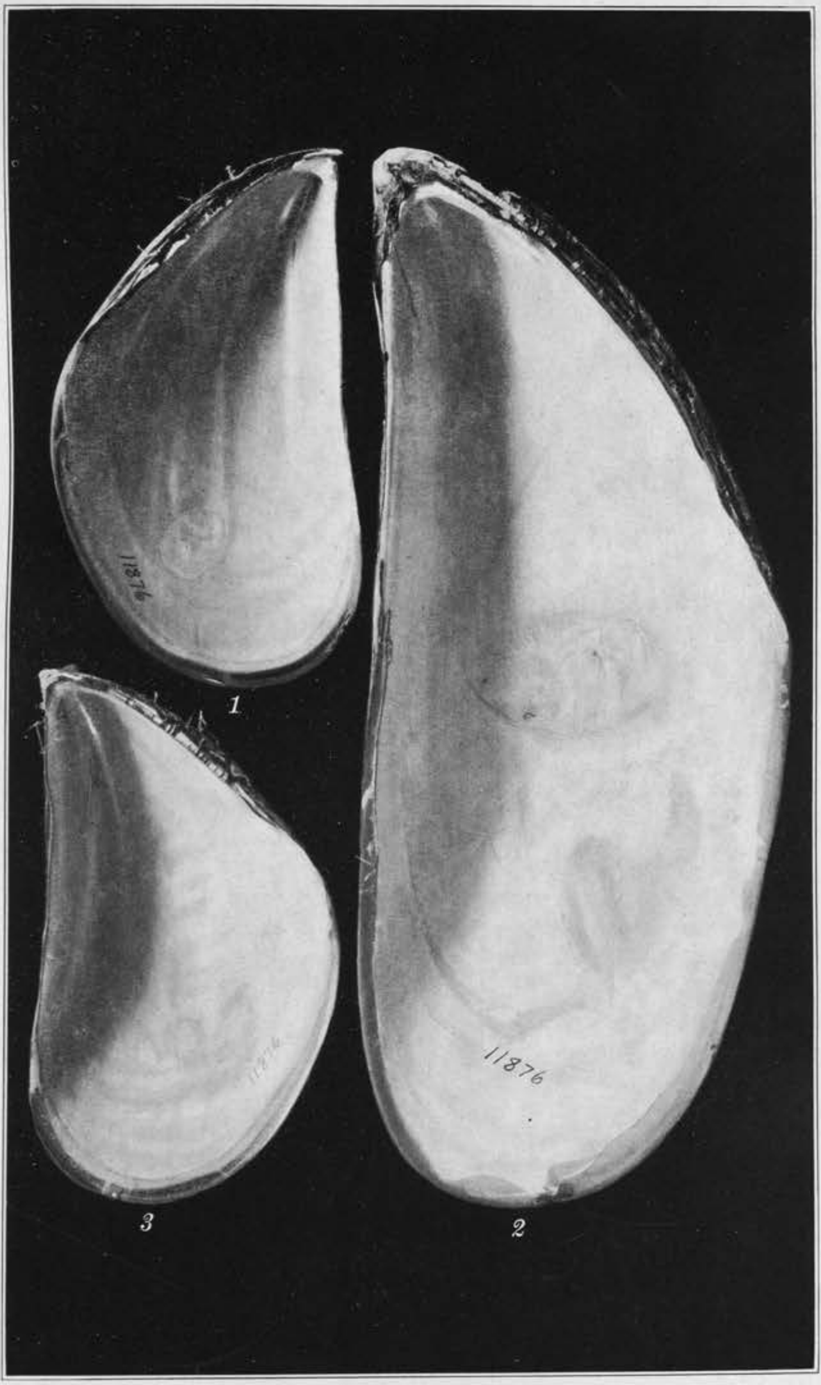

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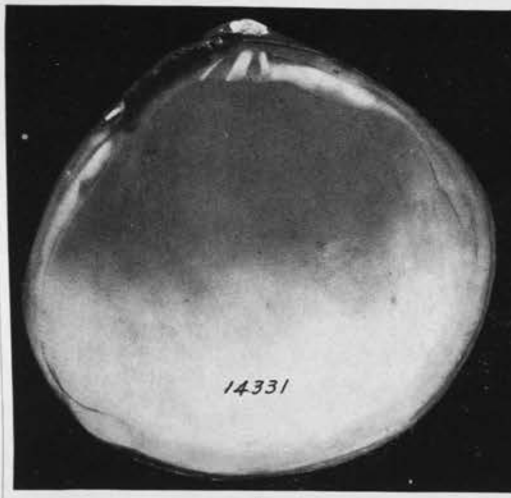

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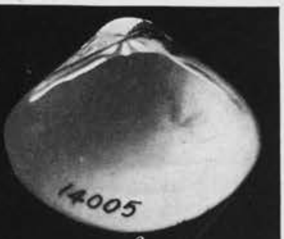

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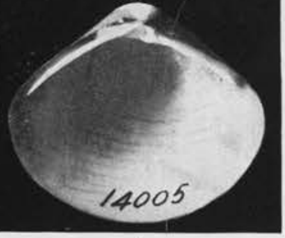

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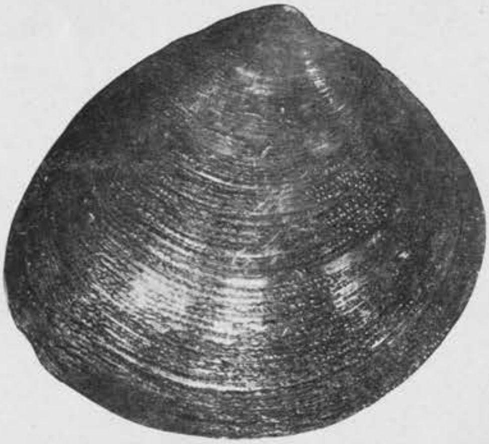

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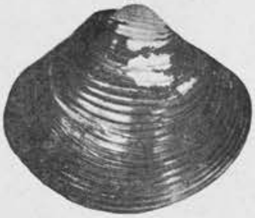

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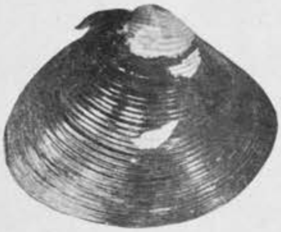

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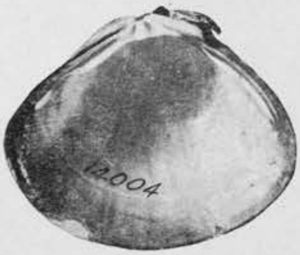

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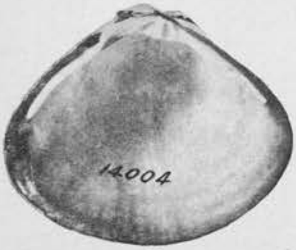

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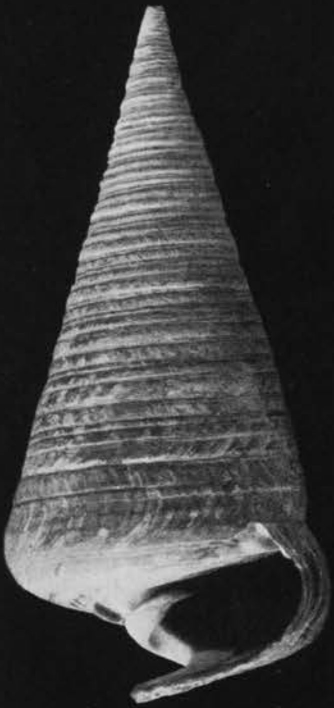

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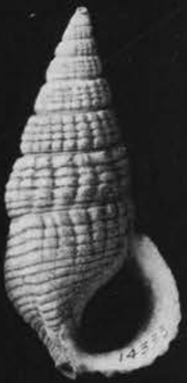

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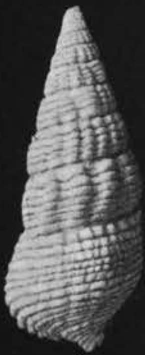

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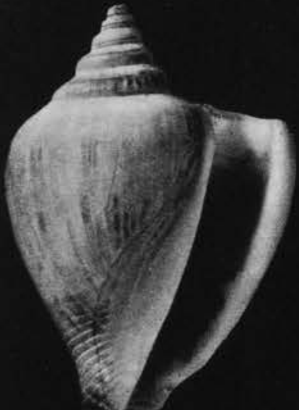

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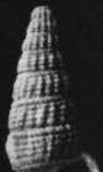

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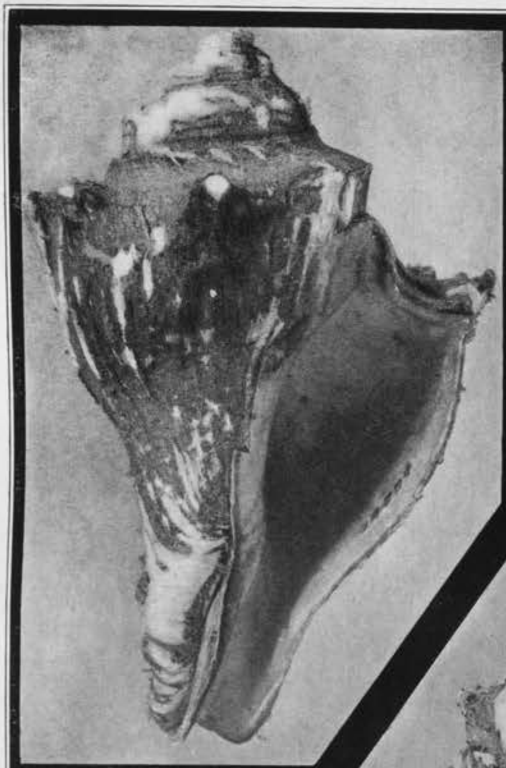
PLATE 15.



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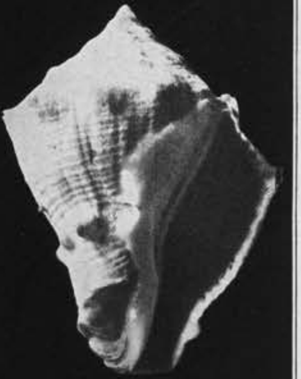

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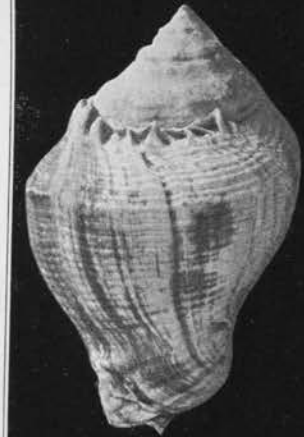

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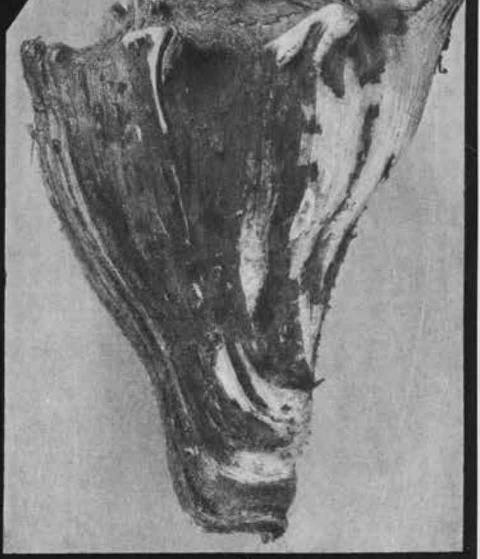

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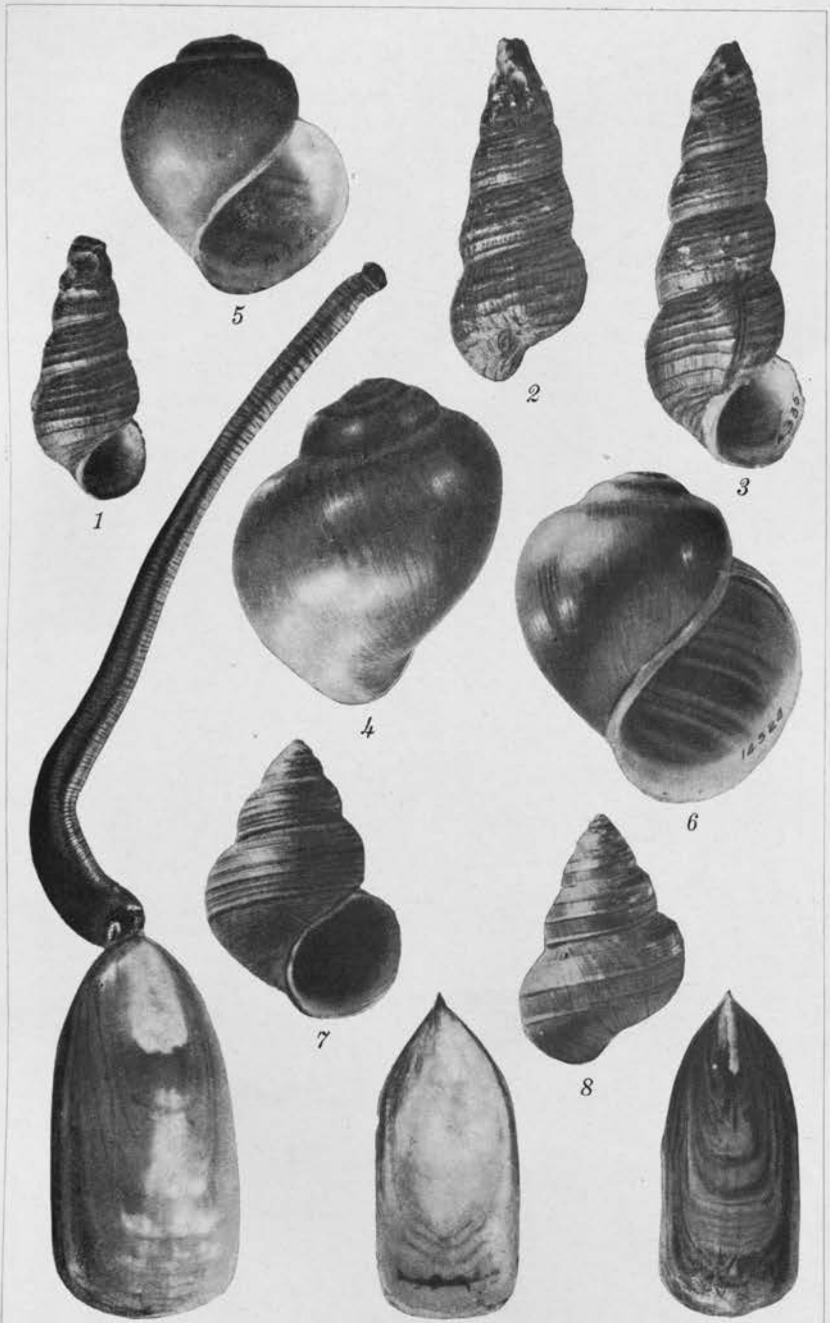

PLATE 17.

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PLATE 18.

PHILIPPINE ALCYONARIA

THE FAMILIES CORNULARIIDÆ AND XENIIDÆ

By HILARIO A. ROXAS

Professor of Zoölogy, University of the Philippines, Manila

FOUR PLATES

In 1912 to 1914 many littoral marine animals were collected in various parts of the Philippine Archipelago through the efforts of members of the Department of Zoölogy, University of the Philippines. The most important localities were Puerto Galera Bay, Sabang Cove, and Calapan, Mindoro Island; Taytay Bay and neighboring small islands near the northern part of Palawan; the shallow regions around Cebu and Bantayan Islands; Mariveles, Bataan Province, at the entrance to Manila Bay; and Legaspi Bay, southern Luzon. The greatest part of this collection was alcyonarian material, some of which was worked out by Light (1913–15), but most of the alcyonarians were sent to Prof. W. Kükenthal, then at the University of Breslau. Small portions were worked out by J. Moser (1919), H. Lüttschwager (1922), and K. Kolonko (1926). After the death of Professor Kükenthal, all the Philippine specimens were transferred to the zoölogical museum of Berlin University and they are there now. When the present writer was sent to Europe for alcyonarian study he had the opportunity of examining all these specimens, the types of previously described Philippine species, and types from other parts of the world, and is thus in a position to deal with them more or less intimately.

The present paper on Philippine Alcyonaria was prepared under the joint auspices of the University of the Philippines and the John Simon Memorial Foundation and is based on collections taken by the writer to Europe in 1931–32. In addition to his gratitude to the University and the Guggenheim Foundation, the author wishes to express his thanks to the authorities of the Berlin and Breslau Museums for their permission to examine their excellent collections and for extending facilities for working. Special mention should be made of the help of Prof. J.

Moser during the preparation of this paper for which the writer is deeply indebted.

THE ALCYONARIANS

The classification of the alcyonarians has been the subject of much controversy for a long time. In recent years, Kükenthal (1925) divided the Octocorallia, a subclass of the Anthozoa, into three orders only; namely, Alcyonaria, Gorgonaria, and Pennatularia, with the families Telestidæ and Helioporidæ under Alcyonaria. As most workers are now agreed on the uniqueness of the anatomy of these two families they should be given separate ranks. This was done by Hickson (1930), who proposed another system of classification. He gave Alcyonaria the rank of a subclass and placed under it six orders; namely, Stolonifera, Telestacea, Alcyonacea, Coenothecalia (family Helioporidæ), Gorgonacea, and Pennatulacea. While the latter system has its merits in that it separates the Telestacea and the Coenothecalia from the Alcyonacea, it still retains them under the Alcyonaria. It is believed that it is better to retain Octocorallia as a subclass and divide it into five orders; namely, Alcyonaria, Telestaria, Coenothecalia, Gorgonaria, and Pennatularia.

While I have great respect for the opinion of the eminent English worker, Professor Hickson, who for the last forty-six years has done much to increase knowledge of the alcyonarians, and while I shall follow him in many instances, I cannot see how both Clavulariidæ and Cornulariidæ can be used as separate families as he proposes. It seems that Cornulariidæ, being the older name, should be retained as the family name and that, at most, it should be divided into two subfamilies; namely, Cornulariinæ and Clavulariinæ. With Telestidæ and Helioporidæ removed from the Alcyonaria, this should be divided as follows:

- Subclass Octocorallia.
    - Order Alcyonaria.
        - Suborder Stolonifera.
            - Family Cornulariidæ.
                - Subfamily Cornulariinæ.
                - Subfamily Clavulariinæ.
            - Family Tubiporidæ.
        - Suborder Alcyonacea.
            - Family Xeniidæ.
            - Family Alcyoniidæ.
            - Family Nephthyidæ.
            - Family Siphonogorgiidæ.
            - Family Fasciculariidæ.

The order should be diagnosed as follows: Alcyonaria are colonial sessile Octocorallia without an axial skeleton and with or without polyp dimorphism. Between the ectoderm and the endoderm is a mesoglœal mass which contains skeletal elements in the form of separate or compact sclerites or other hornlike bodies. Colony formation results from budding of new polyps from small canals, the solenia, which connect the gastral cavities of the older polyps. These canals may be single and may connect the polyps at different levels above the base, or they may form large groups, each called a stolon, which, at the base, form encrusting plates or strands. Out of the cœnenchymal mass extend the free portions of the polyps, which often are also retractile into the cœnenchymal mass.

The alcyonarians fall naturally into two main groups or suborders; namely, the Stolonifera, in which the mesoglœa of the colony is poorly developed so that the polyps, including the anthostele and the anthocodia, stand out separately and are connected only by a thin basal, creeping membrane or strand, or also by transverse bridges above the base; and the Alcyonacea, in which the mesoglœa is highly developed, forming a common mass or syndete around the anthosteles of all the polyps composing the colony. In the Alcyonacea, the free portions of the zooids, the anthocodiæ, collectively form the apodete of Bourne (1900). The limit of 6 mm thickness of the stolon set by Hickson to separate the Stolonifera from the Alcyonacea appears to me rather mechanical. I believe that it is the relative thickness of the stolon in proportion to the size of the anthocodiæ that should be considered. For this reason, it is always best to base the diagnosis, as much as possible, on living animals or on specimens that have been properly made to expand before fixation. One good instance where this is necessary is in the case of *Sympodium.* The English workers, including Hickson (1930) and Thomson and Dean (1931) have it under Stolonifera, Molander (1921) places it under Alcyoniidæ of the Alcyonacea, and Kükenthal places it under the Xeniidæ. The only form of this genus with which I am acquainted is *S. coeruleum* Ehrenberg. If the distinction between Stolonifera and Alcyonacea must be preserved, as Hickson wishes it to be, then *Sympodium coeruleum* should be included under the latter. In this species the thickness of the stolon is great in proportion to the size of the anthocodia, and a creeping but fleshy syndete is present. The absence of the filaments from the ventral and lateral mesenteries, however, as well as the typical, oval biscuit, disc-shaped sclerites places it in the Xeniidæ, rather than in the Alcyoniidæ as Molander holds.

The limits of the suborders being established, it should not be difficult to divide each into smaller groups.

Key to the suborders, families, and subfamilies of the Alcyonaria.

a ^{1}. Anthostele of zooids not united through a common cœnenchymal mass, but only through a transverse or creeping stolon or thin basal membrane .... Suborder STOLONIFERA.

  b ^{1}. Sclerites, when present, widely separate .... Family CORNULARIIDÆ.

    c ^{1}. Basal portions of zooids protected by horny sheath; sclerites absent .... Subfamily CORNULARIINÆ.

    c ^{2}. Basal portions of zooids without horny sheath; sclerites present. Subfamily CLAVULARIINÆ.

  b ^{2}. Sclerites compact to form cylinders and plates. Family TUBIPORIDÆ.

a ^{2}. Anthostele of zooids united by a common cœnenchymal mass. Suborder ALCYONACEA.

  b ^{1}. Filaments absent from the six ventral and lateral mesenteries; sclerites biscuit-form or disc-shaped........ Family XENIIDÆ.

  b ^{2}. Filaments present in all mesenteries; sclerites in the form of sticks, spindles, clubs, double spindles, barrels, and double stars, or their modifications.

    c ^{1}. Zooids (anthocodia) distributed uniformly on upper surface of colony; basic form of sclerites girdled sticks or spindles. Family ALCYONIIDÆ.

    c ^{2}. Zooids united in groups of different sizes; basic form of sclerites warty spindles.

      d ^{1}. Polyp-bearing portion of colony (apodete) not retractile into sterile stalk (syndete).

        e ^{1}. Stalk sclerites uniformly distributed throughout. Family NEPHTHYIDÆ.

        e ^{2}. Stalk sclerites accumulated axislike, in inner portion of cœnenchyme .... Family SIPHONOGORGIIDÆ.

      d ^{2}. Entire polyp-bearing portion of colony (apodete) partly or wholly retractile into the stalk (syndete). Family FASCICULARIIDÆ.

Suborder STOLONIFERA Hickson

"Colonial Alcyonaria with a membranous or ribbonlike stolon. Mesoglœa poorly developed. Polyps either entirely free from one another, excepting at their bases, or connected by horizontal platforms or connecting tubes." (Hickson.)

Family CORNULARIIDÆ Dana

Cornulariidæ DANA, Zoophytes (1846) 627; MILNE-EDWARDS, Hist. Nat. des Corall. 1 (1857) 104; WRIGHT and STUDER, Challenger Report 31 (1889) 252; STUDER, Alcyon. de l'Hirondelle (1901) 11; KÜKENTHAL, Korallthiere des roten Meeres (1904) 39; Alcyonacea der Tiefsee-Expedition **30** (1906) 8; MOLANDER, Kungl. Sv. Vet. Akad. Handl. **51** (1915) 24.

Cornularidæ v. KOCH, Alcyon. Golfes Neapel, Mitt. Zool. Stat. Neapel **9** (1891) 653.

Clavulariidæ HICKSON, Rev. Alcyon. Stolonifera (1894) 329; SCHENK, Clavulariiden, Xeniiden u. Alcyoniiden von Ternate (1896) 43; MAY, Jena Zeitschr. f. Naturw. **33** (1899) 27.

The family Cornulariidæ was established by Dana in 1846; he included under it only the genus *Cornularia* Lamarck, but remarked that *Clavularia* of Quoy and Gaimard, when properly worked out, should also belong to his new family. From the time of Dana to the present there are no less than twenty-six genera that have been described belonging to the family. These genera, arranged in the chronological order of their establishment, are as follows:

Anthelia Lamarck (1816).
Clavularia Quoy and Gaimard (1830).
Sympodium Ehrenberg (1834).
Rhizoxenia Ehrenberg (1834).
Cornularia Lamarck (1836).
Evagora Philippi (1842).
Sarcodictyon Forbes (1847).
Telesto Lamarck (1857).
Coelogorgia Milne-Edwards (1857).
Haimea Milne-Edwards (1857).
Erythropodium Kölliker (1865).
Hartea Wright (1865).
Cyathopodium Verrill (1868).
Gymnosarca Kent (1870).
Callipodium Verrill (1871).
Anthopodium Verrill (1872).
Cornulariella Verrill (1874).
Trachythela Verrill (1874).
Sclerenthelia Studer (1878).
Stereosoma Hickson (1894).
Rolandia de Lacaze Duthiers (1900).
Hicksonia Delage and Herouard (1901).
Pachyclavularia Roule (1908).
Acrossota Bourne (1914).
Parerythropodium Kükenthal (1916).
Solenopodium Kükenthal (1916).

Haimea Milne-Edwards and *Hartea* Wright are supposed to be noncolonial, primitive alcyonarians; but as there is no concrete proof of the existence of these forms, they being possibly nothing but young forms of other species, the genera should be discarded. *Telesto* Lamarck, *Coelogorgia* Milne-Edwards, and *Pseudogorgia* are now placed under a separate order, Telestidæ. The genera *Erythropodium* Kölliker, *Pachyclavularia* Roule, and *Evogora* Philippi have been assigned by Kükenthal (1916) and Molander (1929) to the family Briareidæ of the Gorgonaria, although Hickson (1930) leaves *Erythropodium* and *Pachyclavularia* in the Clavulariidæ. *Rhizoxenia*, according to Kükenthal (1916), should be discarded, and its species should be distributed among *Anthelia* and *Evagora*. *Stereosoma*, according to Light, Schenk, and Kükenthal, is inseparable from *Anthelia*.

Hicksonia is of course *Clavularia,* and the genus should be discarded as soon as possible to avoid confusion in nomenclature. Light says that species of *Rhizoxenia* whose polyps are entirely retractile should be reckoned under *Sympodium. Scleranthelia* is sometimes considered a cornulariid (Studer 1878, Versluys 1907, S. Thomson 1921) and sometimes a telestid (May, 1899, Kükenthal 1906). *Sarcodictyon,* according to Kükenthal (1916), is identical with *Evagora,* the latter also considered by him as being near *Alcyonium.* Hickson (1930) retains *Sarcodictyon* in the Clavulariidæ. *Gymnosarca, Anthopodium,* and *Cyathopodium* have been so insufficiently described that it becomes hard to place them. Discarding the above generic names, there remain eleven to be accounted for; namely, *Anthelia, Clavularia, Sympodium, Cornularia, Callipodium, Cornulariella, Trachytela, Rolandia, Acrossota, Parerythropodium,* and *Solenopodium.* According to Hickson *Anthelia* should be merged with *Clavularia* and only the latter name should be retained. We are, however, reckoning *Anthelia* here as a distinct genus. *Sympodium* in this paper is being treated as a member of the Xeniidæ. *Cornulariella* Verrill has a thin basal stolon or membrane and should probably be retained in the family. *Callipodium* is also a form with creeping stolon over shells of mollusks, and the genus apparently is a valid one. As I have no personal knowledge of *Rolandia, Acrossota, Trachytela, Parerythropodium,* and *Solenopodium,* I shall confine my attention to the Philippine forms of *Cornularia, Clavularia,* and *Anthelia,* as belonging to the family Cornulariidæ. I give the following diagnosis of the family:

The individual polyps are united mostly at the base by a creeping stolon or basal plate into which the polyps are never retractile. The solenia may form a stolon above and connect the various polyps at different levels above the base of the colony. Thus, new polyps may arise either from the colony base or from the transverse stolon. The sclerites are long, slender, sparsely warted spindles, sticks, and clubs; also weakly warted and small, flat or dumb-bell-shaped discs. In some forms sclerites may be absent.

The three genera of the family represented in our collection can be told apart by the use of the following key:

Key to three genera of the Cornulariidæ.

a^1. Basal part of polyps protected by a horny sheath; sclerites absent. *Cornularia* Lamarck.

a^2. Basal part without horny secretion, sclerites present.

b^1. Polyps have calyx (anthostele) into which the distal moiety (anthocodia) can be retracted; pronounced difference in sclerites of upper and lower portion of polyps............ *Clavularia* Quoy and Gaimard.

b^2. Polyps without a distinct calyx (anthostele) into which distal moiety (anthocodia) can be retracted; sclerites all similar. *Anthelia* Lamarck.

Genus CORNULARIA Lamarck

Cornularia LAMARCK, Hist. nat. Anim. sans Vertebres (1816) 127; CUVIER, Regne Animal, Zoophytes (1850) 121, pl. 65, fig. 3; SCHWEUGGER, Hand. d. Naturges. (1825) 425; BLAINVILLE, Manual d'actinologie (1834) 499; MILNE-EDWARDS and HAIME, Hist. Nat. des Corall. 1 (1857) 105.

The genus *Cornularia* was established by Lamarck in 1836 when he described an animal that he called *Cornularia rugosa.* This form, however, had been described by Pallas as *Tubularia cornucopiæ* and thus should be called *Cornularia cornucopiæ* (Lamarck). From the time of Lamarck four valid species of *Cornularia* have been described; namely, *C. cornucopiæ* (Lamarck) from the Mediterranean, *C. crassa* Milne-Edwards from the coast of Algeria, *C. australis* Busk from the coast of Australia, and *C. minuta* Light from the Philippines.

I have seen only one specimen of this genus and I am giving the following diagnosis from a review of the literature:

Cornulariids whose small polyps are united at the base by a slender, cylindrical, creeping stolon which contains usually only a single endodermal canal. Polyps are devoid of sclerites, the stolon and the base of polyps protected by a horny secretion. The distal moiety of the polyps can be partially retracted into the proximal portion, which is surrounded by the horny secretion.

The lone material described by Light (1915) and named *C. minuta* was obtained from Legaspi Bay, Luzon, "growing on colonies of *Siphonogorgia variabilis* Hickson." No. C–2457, University of the Philippines zoölogical collection. The Philippine example of *Cornularia* is not typical of the genus as the basal stolon contains more than one endodermal cavity. Light states that this form is more or less intermediate between *Cornularia* and *Clavularia.* Molander (1929) revised the diagnosis of the genus so as to include *C. minuta,* which has more than one endodermal cavity in the stolon.

CORNULARIA MINUTA Light.

Cornularia minuta LIGHT, Philip. Journ. Sci. § D 10 (1915) 203.

"The very minute colonies are attached to the surface of support by the creeping, anastomosing, threadlike stolons. The polyps arise from the stolons at irregular intervals, and when fully expanded have a maximum length of about 2.5 millimeters, including the tentacles, and a minimum diameter of from 0.3 to 0.4 millimeter just below the tentacles. Each polyp is connected with one or more stolons, each of which contains two or more endodermal canals lying in a thick homogenous mesogloea. These stolons are covered with a very thin, wrinkled, perisarc-like, horny envelope, an extension of which forms a cuplike covering for the basal portion of the polyps. The expanded polyps are slender, and the tentacles are about one third as long as the body of the polyp and bear on either side a single row of from 6 to 10 rather short, thick, cylindrical pinnules. When contracted, the distal portion of the polyp is retracted within the basal, horny covering, which is then coneshaped or beehive-like. There are no spicules." (Light.)

Genus CLAVULARIA Quoy and Gaimard

Clavularia Quoy and Gaimard, Blainville Dict. Sci. Nat. (1830) 499, t. 60; Milne-Edwards, Hist. Nat. des Corall. 1 (1857) 166; Wright and Studer, Challenger Report 31 (1889) 254; Hickson, Revision Alcyon. Stolonifera, Trans. Zoöl. Soc. London 13 (1894); Schenk, Clavulariiden etc. from Ternate (1896) 44; May, Jena Zeitschr. f. Naturw. 33 (1899) 40; Kukenthal, Deutschen Tiefsee-Expedition 30 (1906) 15; Molander, Kungl. Sv. Vet. Akad. Handl. 51 (1915) 28.

Hicksonia Delage and Herouard, Trait's de Zoologie Concrete 2 pt. 2 (1901).

The genus *Clavularia* was established by Quoy and Gaimard in 1830 and confirmed by them after the return of the *Astrolabe.* In 1895, Hickson extended the limits of the genus and included in it *Anthelia* Lamarck, *Rhizoxenia* Ehrenberg, *Sarcodictyon* Forbes, *Gymnosarca* Kent, and *Cornulariella* Verrill; at the same time he created a new genus, *Stereosoma.* According to Schenk and later to May the genus *Stereosoma* should be also included in the large genus *Clavularia.* After examining Philippine material of *Clavularia* and *Anthelia,* I am of the opinion that Kükenthal, Light, and Molander are correct in their conclusion that enough differences exist between the two genera to warrant their separation. I see no reason for discarding either *Clavularia* or *Anthelia* as proposed by Hickson (1930). I have had no opportunity to examine examples of the genus *Stereosoma* Hickson and therefore cannot judge its validity, but I am convinced that the genus *Hicksonia* introduced by Delage and Herouard (1901) and by Dean (1927) cannot be accepted, as the species they used as the type, *Hicksonia viridis*, is also the type of *Clavularia*. The following is a definition of the genus:

Clavularia includes cornulariids whose polyps are united by a basal or transverse stolon or membranous basal plate containing a network of canals. The polyps are usually divided into a basal nonretractile calyx (anthostele) and a distal moiety (anthocodia) that can be withdrawn into the upper portion of the calyx. The sclerites of the lower portion of the polyps are large, strong spindles, sticks, and clubs heavily warted and arranged in distinct rows, and are always different in size and shape from those of the upper portion. Polyps and stolon are without any horny secretion.

With the above definition, three Philippine forms belong to this genus.

CLAVULARIA VIRIDIS Quoy and Gaimard.

Clavularia viridis QUOY and GAIMARD, Voy. de l'Astrolabe Zooph. 4 (1883); MILNE-EDWARDS and HAIME, Hist. Nat. des Corall. 1 (1857) 107; HICKSON, Proc. Royal Soc. 40 (1886) 322–325; WRIGHT and STUDER, Challenger Report, Zoöl. 31 (1889) 297; HICKSON, Willey's Results pt. 4 (1900) 494.

Hicksonia viridis THOMSON and DEAN, Siboga Expedition 13d (1931) 14.

Numerous zooids arise from a creeping cylindrical or platelike stolon; the latter, however, is never extensive. In addition, zooids are united by means of cylindrical transverse stolons at different levels of the calyx. Polyps vary in length even in one colony; they never extend straight up, but always grow at an angle with the substratum and slightly curved. Longer polyps are either tortuous or bent at points where transverse stolons arise from them. Noncontractile portion of zooids, the calyx, as much as 60 mm high, although the majority are 20 to 30 mm long. They vary from 4 to 6 mm in diameter; the apical portion is always slightly distended and marked with eight longitudinal furrows. Introvertible neck and crown, excluding tentacles, 10 to 14 mm long and when inside calyx, 2 to 4 mm in diameter. Tentacles 5 to 6 mm long with slightly flattened axis 0.7 to 0.8 mm wide at base. Pinnules short and stout, one row on either side of axis; nine to eleven pinnules in a row. Sclerites of calyx and stolon long spindles, 1.3 mm long and 0.16 mm wide at middle with prominent projecting thorns. Polyp sclerites, which according to Hickson are absent in the type species of the genus, are present in the crown, neck, tentacles, and pinnules. These are flat, biscuitlike discs about 0.036 mm long and 0.0144 mm wide, usually with a shallow constriction on either side. Base of calyx dirty creamy white. Upper portion of zooids yellowish green.

CLAVULARIA INFLATA Schenk var. LUZONIANA May.

Clavularia inflata SCHENK, Xeniiden und Alcyoniiden von Ternate. Franfurt a. M. (1896) S. 48.
Clavularia inflata var. *luzoniana* MAY, Jena Zeitschr. f. Naturw. 33 (1899) N. F., 44, t. 1, fig. 4; t. 5, fig. 1a, b.
Hicksonia köllikeri DEAN, Proc. Roy. Soc. Edin. 21 (1927).

From a very thin, hard and flat, platelike or creeping stolon numerous zooids arise very close to each other leaving almost no space between their basal portions. Nonretractile part of zooids in form of a calyx with a slightly distended upper portion marked with longitudinal furrows. Calyx 20 to 22 mm high with a diameter of 4 mm at base and 6 mm at upper swollen portion. Between calyx and introvertible portions is a neck which, in contracted condition, is about 3 mm in diameter. Introvertible crown, when contracted, about 5 mm long, tentacles not included. Tentacles solid looking, about 5 mm long and 2 mm wide at base, almost triangular in contracted specimens. Pinnules cover entire inner surface of tentacles, fingerlike with more or less rounded ends, and about 0.7 mm long and 0.16 mm in diameter at base.

Sclerites differ in different parts of zooids. In pinnules and tentacles they are elongate, flat, biscuitlike discs from 0.037 to 0.085 mm long and about 0.011 mm wide. At base of tentacles they are short, stout sticks with fine projections and forked at one end, 0.4 to 0.5 mm long and 0.08 to 0.09 mm wide. At crown, part inclosing tentacles when introverted, sclerites are long regular spindles with rather fine granulations, at most 0.96 mm long and 0.08 mm wide. These sclerites usualy lie in double rows, ten pairs in each double row. Below these are other spindles which lie more or less horizontally. The sclerites of calyx are also spindles about 1.6 mm long and 0.208 mm wide, with long but simple warts scattered irregularly on them. These lie close together, many times overlapping each other, making the calyx hard and brittle. Sclerites of stolon are also spicules but with coarser warting and of stouter build. These are up to 0.99 mm long and 0.09 mm wide. In addition, many sclerites of stolon are of very irregular shape or are branched at tips.

Stolon creamy yellow, calyx dirty yellowish green, the retractile portions deep green.

The type of this variety was obtained from Albay, Luzon, and is now in the Berlin Zoölogical Museum. This is the commonest species of *Clavularia* in the Philippines.

CLAVULARIA VIOLACEA Quoy and Gaimard.

Clavularia violacea QUOY and GAIMARD, Voy. de l'Astrolabe, Zoöl. 4 (1833) 262, pl. 21, figs. 13, 16; MILNE-EDWARDS and HAIME, Hist. Nat. des Corall. 1 (1857) 107; WRIGHT and STUDER, Challenger Report, Zool. 31 (1889) 297.

Numerous thickly set polyps arise from a much-branched, creeping stolon or platelike base. In certain instances the stolon may pass through crevices of dead corals so that the colony instead of being flat, becomes irregular in extent. Polyps are usually connected to each other only by basal stolon, but in certain cases two or three of them may have their basal portions united. Calyx of polyps between 7 and 13 mm high, crown not included, and 1.2 to 2 mm wide. Just below crown, calyx is slightly enlarged. Entire extent of calyx marked by irregular, fine indentations. Between calyx and introvertible portion of polyps is a neck about 1.5 mm high. Tentacles more or less cylindrical, 3 to 3.6 mm long and 0.4 to 0.6 mm wide. Pinnules tiny, rounded, and in one row on either side of tentacle. There are twenty-six to thirty pinnules in a row.

Introvertible parts of zooids without sclerites. Sclerites of stolon and calyx are spindles 0.2 to 0.6 mm long and 0.04 to 0.1 mm wide, with four to twelve whorls of tiny warts. Some sclerites are stouter in build, around 0.3 mm long and 0.12 mm wide, with much heavier warting. Many sclerites may be curved or otherwise deformed.

Calyx reddish violet due to color of sclerites. Introvertible portions dirty creamy white in preserved specimens.

This species has been recorded from Vaniko Island. Philippine material was collected from Mariveles, Luzon.

Genus ANTHELIA Savigny

Anthelia SAVIGNY, Description de l'Egypte; Histoire Naturelle, Supp. 1 (1817); EHRENBERG, Corallenthiere des roten Meeres (1834) 54; LAMARCK, Hist. Nat. Anim. sans Vertebres 2 (1836) 622; DANA, Exploring Expedition, Zooph. 7 (1846) 602; MILNE-EDWARDS and HAIME, Hist. Nat. des Corall. 1 (1857) 109; KÜKENTHAL, Alcyonacea, deutschen Tiefsee-Expedition 12 (1906) 10; MOLANDER, Alcyonacien von Madagascar, Arkiv. f. Zool. Kungl. Sv. Vet. Akad. Handl. 14 (1921) 2.

The genus *Anthelia* was first established by Savigny (1817) when he described a cornulariid alcyonacea which he called *A.*

glauca. The validity of the genus remained unquestioned until 1894, when Hickson in his revision of the Alcyonaria Stolonifera included in *Clavularia* all the animals that had been described under the genus *Anthelia.* Hickson's example was followed by Schenk (1896) and May (1899). Such a move is not warranted by our present knowledge of these animals. To the writer it appears that the genus *Stereosoma* of Hickson is nearer to *Anthelia* than it is to *Clavularia* in which Schenk and May have it included, and certainly there is more difference between *Anthelia* and *Clavularia* than there is between *Anthelia* and *Stereosoma.* Thus, in this paper *Anthelia* is treated as a genus distinct from *Clavularia.*

In 1916, Kükenthal revised the genus *Anthelia* and gave a more or less clear-cut distinction between it and the genus *Clavularia.* The basis of the separation is the absence or presence of a distinct calyx. In *Anthelia* the polyp body is not divided into an apical thin-walled portion and a basal thick-walled calyx and the polyps are nonretractile. In *Clavularia,* however, the polyp body is so divided and the upper thin-walled portion can be retracted into the calyx. Molander (1918), however, stated that a calyx cannot be said always to be absent in *Anthelia,* as in certain cases it is possible that the upper moiety of the polyp may be retracted resulting in a sort of pseudocalyx. Such a retraction occurs in none of the examples of *Anthelia* that I have examined. The distinction that Molander gave, however, is very useful, and I am quoting his diagnosis of the genus *Anthelia* (1921).

I have examined the original specimens of *Clavularia longissima* of May and *Clavularia inflata* of Schenk, both in the Berlin Museum, and I am convinced that they belong to different genera. *Clavularia longissima* has no calyx and all its sclerites are of the same form and size. As such it must be included in *Anthelia.* *Clavularia inflata* has a distinct calyx into the upper portion of which the distal moiety of the polyp can be retracted, and it has several types of sclerites.

To separate the genus from *Clavularia* very distinctly I give a more or less literal translation of Molander's diagnosis of *Anthelia,* as follows:

Cornulariids whose free polyps are united either by a stolon or a thin membranous plate which contains canals arranged netlike. A horny secretion is absent from the polyps. The polyps which are not retractile are thin-walled and simple, not divided into an upper thin-walled and a lower thick-walled part. The sclerites may be absent; when present they are small sticks, discs, or dumb-bells, finely granular or weakly warted. The tentacles often carry several rows of pinnules.

With this definition of the genus, the following species definitely belong to it. Those not enumerated here either belong to other genera or are so insufficiently described that ascertaining their exact position is very difficult.

1. ANTHELIA GLAUCA Savigny.
    Anthelia strumosa Ehrenberg (1834).
    Sympodium filiginosum Ehrenberg (1834).
    Sympodium purpurascens Ehrenberg (1834).
    Anthelia fuliginosa Kükenthal (1904).
    Clavularia garciae Hickson (1894).
    Clavularia ternatana Schenk (1896).
    Clavularia strumosa May (1899).
    Clavularia pulchra Thomson and Henderson (1906).
2. ANTHELIA FLAVA (May).
    Clavularia flava May (1899).
    Clavularia strumosa Thomson and Henderson (1906).
    Clavularia crosslandi Thomson and Henderson (1906).
3. ANTHELIA MARGARITIFERA (Thomson and Henderson).
    Clavularia margaritifera Thomson and Henderson (1906).
4. ANTHELIA REPENS (Thomson and Henderson).
    Clavularia repens Thomson and Henderson (1906).
5. ANTHELIA AMBOINENSIS (Burchardt).
    Clavularia amboinensis Burchardt (1902).
6. ANTHELIA MOLLIS (Thomson and Henderson).
    Clavularia mollis Thomson and Henderson (1906).
7. ANTHELIA PREGNANS (Thomson and Henderson).
    Clavularia pregnans Thomson and Henderson (1906).
8. ANTHELIA REPTANS (Hickson).
    Clavularia reptans Hickson (1894).
9. ANTHELIA LONGISSIMA (May).
    Clavularia longissima May (1899).
    Anthelia lineata Stimpson (1856).
10. ANTHELIA JAPONICA Kükenthal (1906).
11. ANTHELIA PARVULA (Thomson and Henderson).
    Clavularia parvula Thomson and Henderson (1906).
12. ANTHELIA CELEBENSIS (Hickson).
    Clavularia celebensis Hickson (1894).
13. ANTHELIA GRACILIS (May).
    Clavularia gracilis May (1899).
14. ANTHELIA ARMATA Thomson (1927).

To these many species of *Anthelia* I here add six that have to be described as new. The material on which these species are based was recently collected from shallow waters of the Philippines and was taken to Europe for comparison with the recognized species of the genus. Types of the new species are deposited in the University of the Philippines zoölogical collection, and cotypes are to be found in the zoölogical museum of the University of Berlin. The six new species are *Anthelia boquetei, A. palawanense, A. molanderi, A. philippinense, A. elongata,* and *A. rosea.*

Key to the species of Anthelia Savigny.

- a^1. Polyps and colonies with sclerites.
  - b^1. Sclerites oval discs.
    - c^1. Pinnules in four rows on either side, fingerlike.... *A. flava* (May).
    - c^2. Pinnules in three rows on either side, conical.... *A. boquetei* sp. nov.
  - b^2. Sclerites elongate to rhombic, thin and flat discs.
    - c^1. Polyps very small, polyp body and tentacles together less than 5 mm high .... *A. armata* Thomson.
    - c^2. Polyps large, polyp body and tentacles together more than 5 mm high.
      - d^1. Pinnules short, stout, conical.
        - e^1. Polyps short, stout.................... *A. palawanense* sp. nov.
        - e^2. Polyps slender, more than 10 mm high.... *A. molanderi* sp. nov.
      - d^2. Pinnules long, fingerlike or sausagelike.
        - e^1. Pinnules coarse, widely separate, less than ten in a row. *A. philippinense* sp. nov.
        - e^2. Pinnules fine, closely set, more than ten in a row.
          - f^1. Polyp bodies slender and very tall, usually longer than 30 mm.................... *A. elongata* sp. nov.
          - f^2. Polyps less than 30 mm, not very slender.
            - g^1. Polyps medium sized, more than 10 mm high, pinnules usually more than fifteen in a row. *A. glauca* (Lamarck).
            - g^2. Polyps small, never more than 10 mm high, pinnules usually less than fifteen in a row........ *A. rosea* sp. nov.
  - b^3. Sclerites dumb-bell-shaped sticks or capstans.
    - c^1. Sclerites minute capstans, 0.03 to 0.05 mm. *A. repens* (Thomson and Henderson).
    - c^2. Sclerites capstanlike double clubs and double wheels, 0.04 to 0.07 mm.................... *A. margaritifera* (Thomson and Henderson).
- a^2. Polyps and colonies without sclerites.
  - b^1. Tentacles without pinnules.................... *A. amboinensis* (Burchardt).
  - b^2. Tentacles with pinnules.
    - c^1. Pinnules all around the tentacles.
      - d^1. Pinnules long, slender............*A. mollis* (Thomson and Henderson).
      - d^2. Pinnules short, conical.. *A. pregnans* (Thomson and Henderson).
    - c^2. Middle portion of tentacle free from pinnules.
      - d^1. Tentacle very short, about 1 mm................ *A. reptans* (Hickson).
      - d^2. Tentacle 10 mm or longer.................... *A. longissima* (May).
      - d^3. Tentacles 2 and 5 mm long.
        - e^1. Pinnules in one row on either side.
          - f^1. Pinnules long, about twenty in a row. *A. japonica* (Kükenthal).

*f*². Pinnules cylindrical, nine or ten in a row.
A. parvula (Thomson and Henderson).

*e*². Pinnules in more than one row (two to four) on either side.

*f*¹. Pinnules long, featherlike, 0.5 mm long.
A. celebensis (Hickson).

*f*². Pinnules short, wartlike, about 0.2 mm long.
A. gracilis (May).

ANTHELIA FLAVA (May).

Clavularia flava MAY, Jena Zeitschr. f. Naturw. 33 (1899) 43, pl. 1, fig. 3.

Pinnules short, stumpy, in four rows on either side, leaving only the distal half of the tentacular inner surface free. Oval sclerites present all over.

From a rather thick wide basal membrane, numerous polyps arise close to each other. Polyps with bodies from 6 to 15 mm long (without tentacles) and 1 to 1.7 mm wide. Tentacle axis narrow, more or less circular in cross section, 5 to 8 mm long and 0.5 to 0.6 mm wide at base. Pinnules closely set, in four close rows on either side of tentacles. From eighteen to twenty-two pinnules in a row. Pinnules stumpy, but not conical, the longest 0.48 mm long and 0.144 mm wide, the majority much shorter, the distal half of tentacular inner surface almost fully covered by them. Sclerites present all over; minute, flat, oval, biscuitlike discs, 0.0209 mm long and 0.0132 mm wide.

Previously recorded from Zanzibar. Type in Hamburg Museum.

Philippine material is described from an extensive colony growing around a piece of dead stag-horn coral obtained at Taytay, Palawan.

This material differs slightly from the type in having the distal half of the tentacle fully covered by the pinnules. This, however, may be due to a difference in the state of contraction.

ANTHELIA BOQUETEI sp. nov.

Polyps very small, with relatively long tentacles. Pinnules mostly conical, in three rows on either side of tentacle. Entire inner surface of tentacle free. Oval sclerites present.

From a very thin spreading basal membrane, numerous polyps arise very close together, sometimes their bases touching each other. Polyps small and delicate-looking with bodies 2 to 5 mm long (exclusive of tentacles) and 0.5 to 0.8 mm wide, marked with eight fine longitudinal lines. Tentacle axis almost cylindrical, from 3 to 5 mm long and 0.4 to 0.5 mm wide near base.

Pinnules short, fat, and conical, in three rows on either side of inner surface of tentacle. Those near base may be only knoblike. There are usually sixteen pinnules in a row. Largest pinnules near middle of tentacle, about 0.24 mm long and 0.088 mm wide at base. Sclerites present all over, with the form of tiny, flat, oval, biscuitlike discs, 0.019 mm long and 0.013 mm wide.

This new species is described from several extensive colonies growing on pieces of corals obtained from Puerto Galera Bay, Mindoro Island, Philippines.

This species comes closest to *Anthelia gracilis* (May). Unlike this, however, *A. boquetei* has polyps growing very close to each other and has sclerites all over the colonies. In *A. gracilis*, the polyps are 1 to 2 mm apart and sclerites are entirely absent.

ANTHELIA PALAWANENSE sp. nov.

Basal membrane very thin, polyps stout, fat, and low, tentacles wide, truncated, and short, pinnules in two rows, also very short, stout, and conical. Sclerites elongate, narrow discs with finely granular surface.

From a very thin flat continuous basal membrane, numerous densely crowded polyps arise. These are very short and stout, about 3 to 5 mm high (tentacles not included) and about 3 mm wide, with very thick body walls. As a result of partial contraction, the body wall may show several transverse lines or grooves. Tentacles stout, short, and fat, about 2.5 to 3 mm long and 1.2 to 1.4 mm wide. They are contractile but never retractile, showing numerous transverse corrugations. The ends are more or less truncated, never pointed. Pinnules rounded, thick-looking, many times stout cones. They are in two irregular rows on lateral sides of tentacles. The longest are about 0.8 mm long, although the majority are 0.5 to 0.6 mm long and 0.3 to 0.4 mm wide. Sclerites present, uniform throughout. They are tiny, thin, elongate discs with truncated ends, 0.04 to 0.055 mm long and 0.014 to 0.015 mm wide, with finely granular surface. They are thickly arranged, giving a matlike appearance.

The type was collected at Taytay, Palawan, by Light and Griffin in 1914 and labelled *Clavularia*. This specimen, however, must be referred to *Anthelia* as the sclerites are the same throughout and no portion of the polyp body that can be called a calyx is present. Polyps, although clearly contractile, are not retractile, either partially or fully.

ANTHELIA MOLANDERI sp. nov.

Polyps medium sized, with thick body wall. Tentacle axis lanceolate. Pinnules short, stout, often conical, in two rows on either side of the tentacle. Sclerites elongate thin discs.

From a rather thick basal membrane numerous medium-sized zooids arise close together with their bases touching each other. Body of polyp, excluding tentacles, 12 to 16 mm high and 2 to 2.5 mm wide; body wall thick and smooth. Tentacles with somewhat flattened, lance-shaped axis gradually tapering towards the tip, 6 to 8 mm long and 0.8 to 0.96 mm wide near base. Pinnules short, stout, mostly conical in two close rows on either side of the free median surface of tentacle. The longest measure 0.6 to 0.8 mm long and 0.12 to 0.17 mm wide, usually only five times as long as wide. There are from fourteen to twenty pinnules in a single row. Sclerites most numerous on body wall and basal plate, less in tentacles and pinnules. They are elongate, thin discs, about 0.035 mm long and 0.0088 mm wide with rounded ends.

This form differs from most of the Philippine species of *Anthelia* in having short, stout, conical pinnules which are very closely set. The polyps are much longer and slenderer than in *A. palawanense*. The tentacles, which in *A. palawanense* are blunt, stout, and short, are here slender and pointed.

Type: No. 3095–C, University of the Philippines zoölogical collection.

ANTHELIA PHILIPPINENSE sp. nov.

Polyps large, with thick body walls, pinnules large, cylindrical, in two rows on either side of tentacle. Sclerites elongate, truncate discs present in all parts.

From a rather thick basal membrane, about 3 to 4 mm in thickness, numerous zooids arise with their bases close together. Polyps tall with thick firm-looking body wall measuring 28 to 35 mm high (without tentacles) and 4 mm in diameter. Tentacles long with a cylindrical axis tapering towards the tip, 10 to 12 mm long and 0.8 mm wide near base. Pinnules coarse looking, widely separated, cylindrical, and fingerlike with rounded tips. They are in two rows on either side of tentacle; apically they may appear as if only in one row. There are eight to ten pinnules in a row. The majority are about 2 mm long and 0.34 mm wide. A few are much shorter, even less than 0.5 mm long. Sclerites are present all over the polyps and the basal membrane. They are tiny rod-shaped sticks 0.044 mm long and 0.009 mm wide with truncated ends and minutely granular surface. Color of colony in spirit is light yellowish green.

Collected at Puerto Galera, Mindoro.

This differs from other forms of *Anthelia* in having large and widely separated, coarse-looking pinnules, much like those of *Stereosoma celebense* Hickson. Unlike this, however, the colony is contractile, especially the pinnules which may become curled or bent in various ways when touched or badly fixed, and sclerites are present.

ANTHELIA ELONGATA sp. nov.

Pinnules long, cylindrical, in two rows on either side of cylindrical tentacle. Polyps tall and slender, about 45 mm high and 2 mm wide. Sclerites present.

From a thick incrusting, flat, basal membrane about 2 mm thick, numerous zooids arise with their bases almost touching each other. Bodies of zooids long and slender, the longest more than 45 mm high and 1.5 to 3.0 mm wide, excluding tentacles. Body wall somewhat thick but not firm. Tentacles slender with a cylindrical axis 8 to 10 mm long and 0.4 to 0.5 mm wide near base. Pinnules in two close rows on either side of tentacle. Apically the pinnules may appear as if in a single row. They are long and cylindrical with a blunt end, the longest measure 1.5 to 1.8 mm long and 0.16 mm wide. There are from fifteen to twenty-two pinnules in a row. Polyp body as well as tentacles and pinnules sparsely provided with tiny sclerites. These are rod-shaped, slender sticks with blunt ends and with the surface finely granular. They are 0.0518 mm long and 0.0074 mm wide. Color in life deep brown. Very common in Puerto Galera Bay, Mindoro, Philippines.

This form is closest to *Anthelia longissima* (May) in external appearance. May's type, however, did not have any sclerites and he pictures the species as always having an enlarged portion of the polyp body just below the tentacles. This, however, is not constant and it may be due to fixation or preservation. I have seen this species in life, in its natural habitat, and such an expanded portion of the body is not present. When fixed or placed in preservatives, the entire body has a tendency to contract, forcing the contents of the gastral canal upward and downward. For this reason many specimens of *Anthelia* exhibit enlarged body portions either near the base or just beneath the mouth. May describes his material as having only one row of pinnules on either side of the tentacle. In this new species there are two very distinct rows.

ANTHELIA GLAUCA Savigny.

Anthelia glauca SAVIGNY, Des. d. l'Egypt Hist. Natur. Supp. 1 (1817); EHRENBERG, Corallenthiere des roten Meeres (1833) 54; LAMARCK, Hist. Nat. Anim. sans Vertebres 2 (1836) 622; KÜKENTHAL, Alcyon. Tiefsee-Exp. 33 (1906) 11; MOLANDER, Archiv f. Zool. 14 (1921) 6.

Clavularia garciæ HICKSON, Rev. Alcyon. Stol., Trans. Zool. Soc. 13 (1894) 341, pl. 44.

Clavularia ternatana SCHENK, Abhandl. Senckenb. naturf. Gesellsch. 23 (1896).

Clavularia strumosa MAY, Jena Zeitschr. f. Naturw. 33 (1899) 42, pl. 1, fig. 2.

Clavularia pulchra THOMSON and HENDERSON, Proc. Zoöl. Soc. London (1906) 405.

I am referring to this variable specimens of the *Anthelia* most commonly found in Philippine waters. They all agree in having medium-sized colonies whose polyps are united at the base by a basal membrane and with fairly thin body wall, long tentacles with lanceolate axis and with elongate, sausage-shaped, closely set pinnules with pointed ends, usually in two rows. Polyps usually close together. Sclerites are tiny, flat, elongate, truncated discs.

In several colonies, polyps are short with relatively stout bodies, 6 to 12 mm long (tentacles not included), often the swollen basal portions 4 to 5 mm in diameter. Apically, body narrows to about 2 mm in diameter. Tentacle axis slightly flattened and gradually tapering to tip, 4 to 5 mm long and 0.6 to 0.8 mm wide at base. Pinnules in two rows, fingerlike, 1.0 to 1.4 mm long and 0.2 to 0.3 mm wide at base. There are usually thirteen or fourteen pinnules in a row. Sclerites numerous, rodlike sticks with minutely granular surface, 0.042 mm long and 0.0074 to 0.011 mm wide. Light creamy yellow.

In second group of colonies, polyps are as much as 20 mm high and 2 to 5 mm wide (tentacles not included). Tentacles 11 to 14 mm long and 2 to 3 mm wide near base. Pinnules in two rows, 1.5 to 3 mm long and 0.2 to 0.23 mm wide near base. There are sixteen to twenty pinnules in a row. Entire colony beset with numerous sclerites, elongate, tiny, blunt, rodshaped discs with minutely granular surface, 0.057 mm long and 0.0085 mm wide. Creamy white or yellowish green.

In a third group of colonies, body wall thin and transparent probably from long preservation, 10 to 20 mm long and 2 to 3 mm wide. Tentacle axis more or less flattened, about 10 mm long and 0.96 mm wide at base. Pinnules also in two alternating rows, fingerlike, pointed at tip, the longest 1.5 mm long and 0.39 mm wide at base. Sclerites flat, tiny, narrow discs, 0.033 mm long and 0.39 mm wide.

All of the specimens of *Anthelia* sent by Griffin and Light to Kükenthal in 1914, which are also in the Berlin Museum, belong to this species. I have examined the type of Schenk's *Clavularia ternatana* and I believe that it should also be included under this species. I have not seen *C. garciæ* Hickson and *C. pulchra* Thomson and Henderson, but from the description and illustration of the former and the description of the latter, I gathered that they should also be included under *A. glauca,* which is a very variable species, as all workers of the group know.

ANTHELIA ROSEA sp. nov.

Polyps small with bodies never more than 10 mm high, connected by a very thin encrusting basal membrane. Tentacles with cylindrical tapering axis. Pinnules in two close rows. Sclerites elongate, thin, narrow discs.

Polyps small, either closely set, with their bases almost touching each other, or separated by about 1 mm and connected by a thin basal membrane. Polyp bodies usually between 5 and 6 mm high (tentacles excluded) and about 2 mm in diameter. A few may reach a height of 8 mm but never more than 10 mm. Tentacles firm looking, with cylindrical, abruptly tapering axis, 4 to 5 mm long and 0.6 to 0.7 mm wide at base. Pinnules very long in proportion to size of polyps and length of tentacles. They are in two close rows on either side of the free median surfaces of tentacle. There are twelve to fifteen pinnules in a row, the longest 1.1 mm long and 0.24 mm wide at base. Sclerites present all over, in basal membrane, body wall, tentacles, pinnules, and even mesenteries. They are elongate, narrow, thin discs, about 0.033 mm long and 0.007 mm wide.

The type is an extensive colony growing on a piece of sponge. The tentacles when fully expanded are very regularly arranged around the mouth and appear like petals of a flower. It approaches *A. boquetei* in size, but the spiculation and the pinnules are distinctly different.

Type: No. 5013–C, University of the Philippines zoölogical collection. Collected at Puerto Galera.

Family XENIIDÆ Verrill

Xenina EHRENBERG, Abh. Akad. Berlin (1832) 277.
Xeninæ DANA, Zoophytes (1846) 604.
Alcyoninæ MILNE-EDWARDS, Hist. Nat. des Corall. 1 (1857) 113, 125.
Xeniadæ GRAY, Ann. & Mag. Nat. Hist. 14 (1859) 433.
Xeniidæ VERRILL, Proc. Essex Inst. 4 (1866) 148.
Alcyoninæ exsertæ KLUNZINGER, Die Korallthiere des roten Meeres 1 (1877) 39.

The family Xeniidæ, as originally constituted, with the exception of two species, *Xenia antarctica* and *X. wandeli* (Arctic Ocean), is wholly tropical or subtropical in distribution, mostly found in the Indian Ocean, the Red Sea, and the Pacific Ocean. Practically all known members of the Xeniidæ are inhabitants of very shallow waters; except *Xenia antarctica* and *X. wandeli*, none has been collected from deep waters. Recently, however, the genus *Sympodium* with many deep-sea and cold-water species has been included in this family.

In the Philippines, the members of the family are mostly encountered on very shallow reefs located in well-protected bays or in coves unexposed to the prevailing wind. This is beautifully illustrated in the Puerto Galera region, Mindoro. Many members of the group thrive best in the almost land-locked Puerto Galera Bay and in that part of Sabang Cove where the water is quiet and the place unexposed to the strong prevailing northwest wind. They are conspicuously absent in more-exposed regions, such as Varadero Bay and the shores of Maricaban and Verde Islands. They are usually attached to old or new pieces of coral just above the lowest tide level. A few are located at a higher level, so that during low water they are seen as irregular limp masses partially covering the stones to which they are attached. In life they are variously colored, although the majority exhibit light hues of yellow, brown, blue, and lilac. A colony seldom has one general color. Usually the stalk, the polyp bodies, and the tentacles are differently tinged.

Practically all students of this group, including Ashworth, Bourne, Hickson, Kükenthal, Light, May, Schenk, Thomson, and Henderson, complain of the difficulty in working out the family due to the instability of the diagnostic characters used. The writer is cognizant of this difficulty and to obviate errors as much as possible, a uniform method of collection and preservation is used in working out the Philippine forms. The animal and, if possible, the piece of stone to which it is attached, is carefully lifted and placed in a blue pan with a sufficient amount of sea water. Its color, the general condition of the tentacles and pinnules, such as their shape and extent, are studied. The animal is then transferred to another pan and anæsthetized by the use of a gradually dissolving bag of magnesium sulphate. When it is fully expanded and shows no sign of capacity to contract, it is transferred to a 10 per cent solution of formalin in sea water.

Detailed study of the specimen, such as counting the rows of pinnules and the number in a row and measuring the various parts, is made in the laboratory. By this uniform method, error arising from the difference in the state of contraction of the tentacles and pinnules is eliminated to a great extent. Measurements of very small parts, as the length and breadth of the tentacles, the length and diameter of pinnules, and dimensions of spicules, are made with an ocular micrometer. When the pinnules are long and very closely set, counting rows and the number in a row is difficult. In such a case, the tentacle is split longitudinally along the mid-external and internal lines and the counts are made from the inside.

Xeniidæ are Alcyonacea with polyps united basally through a mass of cœnenchyme which is traversed by an extensive endodermal canal system. The united portions of the polyps form a fleshy, soft base or stalk, usually columnar, sometimes branching or spreading, from which the nonretractile free portions of the polyps extend. Often the apical portion of this stalk forms an expanded disc or capitulum, as in *Xenia* and *Heteroxenia,* which forms a sort of boundary between the exposed sexual portion and the basal, concealed, nonsexual portion of the polyps. The polyps are usually numerous, well spaced or closely set, on the upper portion of the stalk. Often they are so thickly crowded that very little, if any, of the upper surface of the capitulum is visible.

In *Cespitularia* the stalk is much branched and no definite capitulum can be said to exist. The polyps are either monomorphic (*Xenia, Cespitularia,* and *Sympodium*) or dimorphic (*Heteroxenia*). The free portion of the polyps may arise from about the same level on the capitulum (*Xenia* and *Heteroxenia*), at different levels of the stalk (*Cespitularia*), or from a basal stolon (*Sympodium*). The surface of the stalk when present is usually smooth, but at times it may be traversed by fine or large and shallow longitudinal grooves. The periphery of the capitulum is often marked by very fine, short, vertical ridges.

Many species, upon handling, secrete a thick or thin mucous substance, the nature, origin, and use of which are unknown.

As additional characteristics of the group may be added the presence of digestive goblet cells in the stomodeum which are ectodermal in origin and the absence of the six ventral and lateral mesenterial filaments. Only the two dorsal filaments are present. The single ventral groove of the stomodeum, the siphonoglyph, is provided with cilia only on its basal third. The retractor muscles, which are well developed in most alcyonarians, are either wanting or very poorly developed in the group.

The spicules of the group are characteristic. They are more or less uniform in structure and size in all the species, and serve, more than any other structure, to bind the different members together into a distinct group. The spicules are mostly located on the external surface of the polyps in the mesoglœa just beneath the ectoderm. These are minute and thin discs usually oval or elliptical, sometimes more or less oblong with a slight, hardly visible constriction at the sides. On the average they have a long diameter of 0.02 mm and a short diameter of 0.012 mm. In transmitted light they appear yellowish, but in reflected light they appear whitish. They readily stain with any kind of hæmatoxylin stain. According to Bourne (1895) this is due to the fact that they are "somewhat feebly calcareous, and contain an abundant organic basis." In both the autozooids and siphonozooids they are usually least abundant towards the base of the zooids. They come in greater numbers apically where they are crowded on the external surface of the tentacles. In the case of autozooids they are usually numerous and crowded together on the pinnules when present.

Of great taxonomic value is the character of the tentacles and pinnules. The tentacle axis is either flattened or columnar, tapering to a point, either tongue-shaped, lanceolate, or nearly of uniform width for the greatest extent. The tentacle is always provided with pinnules, usually situated on its internal surface, but at times also on its external surface. These pinnules, which vary in shape from rounded or pointed wartlike cones to much elongate, filiform ones, are in two series of one to five regular or irregular rows on either side of the inner median line of tentacles. In some forms the series are far apart and leave a wide bare space of the tentacle between them. In others, however, the two series approach each other very closely so that only a very narrow space, if any, is left between them. In the latter case, the tentacle or its part is said to be not "free."

On the basis of the length and shape of pinnules, Schenk (1896) divided the genus *Xenia* into three subgenera; namely, those with long pinnules throughout the whole length of the tentacles, those with short pinnules basally and long apically, and those with short pinnules throughout. It must be said, however, that whether the pinnules are long or short, those at or towards the base are always much smaller than those towards the middle, and usually many intermediate forms come between the three subgenera of Schenk. Even in the forms having the majority of pinnules much elongate, filiform, and pointed, those at or towards the base may be in the form of short, rounded warts.

In this paper, the family is treated as having four distinct genera; namely, *Heteroxenia, Xenia, Cespitularia,* and *Sympodium.* The last three are universally accepted as valid genera. Opinions vary with regard to *Heteroxenia,* and a long and picturesque controversy over its validity has been going on in the last century and a half.

Kölliker in 1874 described *Heteroxenia elizabethæ* and found many small individuals in addition to the ordinary large ones. He considered that among the small forms two kinds exist; some are young polyps in various stages of development, but the majority are zooids. According to him there is a distinct dimorphism in the genus *Heteroxenia,* the polyps are large and sexual with prominent tentacles and pinnules, and with a cœlenteron extending far into the stem, while the zooids are more numerous, small, and never grow beyond a certain maximum size; they are nonsexual, with abbreviated tentacles not provided with pinnules, and with a cœlenteron not extending far into the stem.

Klunzinger, working on the Xeniidæ of the Red Sea, saw very many polyps in one member of the family. He noted that small individuals never develop into fully formed polyps, but "remain in the bud-like stage, with short, simple, mostly incurled tentacles." Instead of describing this species under *Heteroxenia,* he called it *Xenia fuscescens* and placed it near *Heteroxenia elizabethæ* of Kölliker.

Haacke (1886), working on the Xeniidæ of Torres Strait, said that the small and apparently rudimentary forms are nothing but young polyp buds and that he found all stages between them and the adult polyps. It is certain that Haacke was right in his observation, but whether he was working with a form of *Xenia* or *Heteroxenia* is still a question.

Wright and Studer (1889), in the Challenger Report, briefly noted these statements of Klunzinger and Haacke and proposed the temporary abandonment of the genus.

Bourne (1895), working on *Xenia umbellata* var. *coerulea* and *Xenia garciae* from Diego Garcia Island (Indian Ocean) and on a colony of *Heteroxenia* from Zanzibar, stated that Kölliker's genus is valid and that Haacke's "criticisms must have been founded on a study of members of the genus *Xenia,* which are abundant in the Torres Strait and Great Barrier Reef of Australia." To him there is no doubt that in *Heteroxenia* a distinct dimorphism occurs.

Schenk (1896), who described several new forms of *Xenia* from Ternate, remarked that he believes the zooids of Kölliker are merely young polyps and supported Haacke's view that no dimorphism exists in the Xeniidæ. In fact, he transferred *Heteroxenia elizabethæ* to *Xenia.* Schenk's example was followed by May (1899).

Hickson (1902), working on the alcyonarians of Cape of Good Hope and recognizing the results of Kölliker, Bourne, and Ashworth, founded a new species which he called *Heteroxenia capensis.*

Following the example of Ashworth (1899), I studied autozooids of various sizes of a form I am calling *Heteroxenia mindorensis.* Table 1 shows that as the polyp increases in length, there is a corresponding increase in the length of the tentacles and in the number of pinnules. A similar study, however, of the siphonozooids, Table 2, shows no corresponding increase in the length of the tentacles as the zooids increase in length. In none of the siphonozooids have pinnules been found, although many or all of them are longer and larger than the youngest autozooids.

Histological studies on the two kinds of zooids of *Heteroxenia mindorensis* confirm Ashworth's observation that in both siphonoglyph with cilia toward the basal part is present. The cœlenteron of the autozooid extends down into the base of the syndete and always has a slightly expanded end. That of the siphonozooid, however, never extends for more than 2 mm into the syndete and has always a pointed end uniting with the superficial canal system. That the autozooids are sexual and the siphonozooids are not is beautifully illustrated in the serial sections of my specimen.

The two dorsal mesenterial filaments in the siphonozooids, unlike those in the autozoöids, are very inconspicuous and short, and extend only for a very short distance below the stomodeum. In the autozooids these two dorsal mesenteries are very highly developed, more or less convoluted, and they extend up to the base of the cœlenteron. The mesenteries themselves are very thin in the siphonozooids, not more than 0.01 mm thick, against the usual 0.05 mm mesenterial thickness in the autozooid. As first pointed out by Ashworth (1899) no trace of retractor muscles is found in the mesenteries of the siphonozooids. These muscles are very prominent in all mesenteries of autozooids that I have examined.

After the examination of all the material on hand, I am of the belief that the difficulty in visualizing the validity of this genus lies in the fact that heretofore only one species of the genus, *Heteroxenia elizabethæ,* has been extensively studied and described. In this paper I am describing seven forms besides *Heteroxenia elizabethæ,* all of which show a distinct dimorphism. I am certain that none of these is identical with *H. capensis, H. rigida* May, or *H. uniserta,* the only species except *H. elizabethæ* (*X. ashworthi* of Kükenthal) known to possess dimorphism. It is to be regretted that in spite of the recent splendid work of Hickson on the Xeniidæ (1930), Thomson and Dean (1931) did not adopt the genus *Heteroxenia;* they referred *H. capensis* and *H. elizabethæ* to *Xenia* as *X. capensis* and *X. ashworthi,* respectively.

The siphonozooids of all of the species of *Heteroxenia* described here are more or less alike despite obvious dissimilarities of the autozooids. If these small siphonozooids are nothing but young developing polyps, they should at least show more diversity in size, because it is quite unnatural that so many developing young polyps of the same size should be found at one time when the older polyps themselves are of various sizes. Light (1915), discussing the same point, said, "The number of siphonozooids is so great in proportion to the number of autozooids, their size is so uniform and so much less than that of the autozooids, and these conditions have been noted by so many independent workers from specimens from so many widely separated habitats that it seems hardly conceivable that we have here merely growing polyps."

In life, full-grown examples of *Heteroxenia* can be told from *Xenia* by the much crowded arrangements of the two kinds of zooids, leaving no portion of the external surface of the capitulum exposed. It appears in practically all species of *Heteroxenia* I have examined that the autozooids develop in the colony much earlier than the siphonozooids. This is borne out by the fact that in places where most of the young developing autozooids are located, as along the outer margin of the disc, very few or no siphonozooids are to be found. It is in the center of the colony, where adult autozooids are mostly located, that numerous siphonozooids are also found. Furthermore, in very small colonies of *Heteroxenia,* the siphonozooids are entirely wanting, appearing only after the colony has attained a certain size. This is shown in the following table of different colonies of *Heteroxenia philippinensis:*

Colony No.—	Basal diameter.	Diameter of terminal disc (capitulum).	Siphonozooids.
	mm.	*mm.*	
1	5	8	Entirely absent.
2	6	11	Do.
3	7	15	Do.
4	9	20	At center of disc only, none towards periphery.
5	12	19	At center of disc only, one towards periphery.
6	15	26	Present all over.
7	16	29	Do.
8	20	32	Do.

The youngest autozooids can be distinguished from the siphonozooids as they are very solid-looking from the very beginning and more or less rounded, about 1 mm or less in length and 0.4 mm in diameter. Very soon the apical end flattens and begins to divide into eight knobs which represent the rudiments of the tentacles. These knobs, which are already present in polyps 1.5 mm long, are 0.2 to 0.3 mm long and 0.16 mm wide at first. The tentacles when just growing out increase in length much faster than the polyp body, and those that are 0.6 to 0.7 mm long have already two or three small wartlike pinnules on their sides. The tentacles may not grow at the same rate, sometimes two or three growing much faster than the others. In the same young polyp, some tentacles may already have seven or eight pinnules, although some may still show none. Despite the difference as to time and space in the development of the two kinds of zooids in *Heteroxenia,* there is no indication of intermediate forms existing between monomorphic and dimorphic xeniids, and I can confirm Hickson's statement that "dimorphism is an established physiological condition" in *Heteroxenia.* I have examined very numerous living xeniids and I am convinced that "a Xeniid is either dimorphic or it is not." (Hickson, 1931, p. 142.)

TABLE 1.—*Measurements of the autozooids of Heteroxenia mindorensis.*

Autozooid.	Length of polyp, including tentacles.	Width of polyp.	Length of tentacles.	Pinnules in outermost row.
	mm.	*mm.*	*mm.*	
A_1	20.0	1.0	7.0	21-23
A_2	17.0	2.2	8.0	20-21
A_3	13.0	0.9	6.8	20-21
A_4	11.0	0.8	6.0	19-21
A_5	8.0	0.7	5.0	15-17
A_6	5.4	0.6	3.5	13
A_7	4.0	0.5	2.2	11-12
A_8	3.0	0.8	1.4	7-8
A_9	2.5	0.8	0.9	4-7
A_{10}	1.8	0.7	0.6	2-3
A_{11}	1.5	0.5	0.2	None.
A_{12}	0.8	0.4	None.	None.

TABLE 2.—*Measurements of siphonozooids of Heteroxenia mindorensis.*

Siphonozooid.	Length of zooid.	Width of zooid.	Length of tentacles.
	mm.	*mm.*	*mm.*
S_1	3.8	1.3	0.32
S_2	3.7	1.4	0.48
S_3	3.6	1.2	0.42
S_4	3.2	1.2	0.3
S_5	3.0	1.1	0.34
S_6	3.0	0.96	0.38
S_7	2.9	0.98	0.32
S_8	2.8	0.96	0.34
S_9	2.4	0.8	0.45
S_{10}	2.4	0.96	0.35
S_{11}	2.3	0.9	0.32
S_{12}	2.0	0.8	0.3

Genus XENIA Lamarck

Xenia LAMARCK, Hist nat. an. s. Vert. 2 (1816) 409; SAVIGNY, Descr. de l'Egypte, Hist. nat. Suppl. 1 (1817) 227; tab. 1, figs. 3–I to 3–VIII; SCHWEIGGER, Beob. naturh. Reisen (1819) 94; EHRENBERG, Abh. Akad. Berlin, ann. 1833 (1834) 277; KLUNZINGER, Korallthiere des roten Meeres, Theil 1 (1877) 39; SCHENK, Abh. Senckenb. naturf. Ges. Frankfurt 23 (1896) 54; MAY, Jena Zeitschr.

f. Naturw. 33 (1899) 80; ASHWORTH, Willey Zoöl. Results, pt. 4 (1900) 522; KÜKENTHAL, Rev. Alcyon. Zoöl. Jahrb. Syst. 15 (1902) 635–662; HICKSON, Great Barrier Reef Exp., 1928–29 No. 5 4 (1931) 148.

To give the history of this genus is more or less superfluous in the light of the recent works of Kükenthal (1902) and Hickson (1931). It is probably sufficient to summarize the findings of Hickson for the benefit of those who have no access to his paper (1931). There have been no less than thirty-two animals described as belonging to the genus since Lamarck described the first species, *Xenia umbellata.* Hickson reduced these to thirteen valid species, and six species of uncertain status due to insufficient descriptions. The following species, together with their synonymy, are considered valid by Hickson:

1. XENIA UMBELLATA Ehrenberg.
    - *Xenia fuscescens* Ehrenberg.
    - *Xenia coerulea* Ehrenberg.
    - *Xenia bauiana* May.
    - *Xenia sansibariana* May.
    - *Xenia tumbuatana* May.
    - *Xenia quinquicerta* May.
    - *Xenia medusoides* May.
2. XENIA ELONGATA Dana.
3. XENIA HICKSONI Ashworth.
4. XENIA PLICATA Schenk.
    - *Xenia blumi* Schenk.
    - *Xenia rubens* Schenk.
5. XENIA CRASSA Schenk.
    - *Xenia fusca* Schenk.
    - *Xenia viridis* Schenk.
    - *Xenia membranacea* Schenk.
6. XENIA MULTISPICULATA Kükenthal.
7. XENIA NOVAE-BRITANNIAE Ashworth.
8. XENIA TERNATANA Schenk.
9. XENIA NANA Hickson.
10. XENIA CROSSLANDI Kükenthal.
    - *Xenia rigida* Thomson and Henderson.
11. XENIA GARCIAE Bourne.
12. XENIA ANTARCTICA Kükenthal.
13. XENIA WANDELI Jungersen.

The following, due to insufficient descriptions, were considered by him as doubtful species: *Xenia florida* (Lesson), *X. danæ* (Verrill), *X. samoensis* (Studer), *X. ochracea, X. brunnea,* and *X. pulsitans* (Saville Kent).

In this paper *X. danæ* is considered a valid species, and *X. sansibariana, X. blumi, X. viridis,* and *X. membranacea* are treated as distinct species contrary to the above given synonymy.

Of the species enumerated above, eight have been identified as being present in the Philippines. It is worth mentioning that the eight old species, whose Philippine records are herein first given, have been reported also from either Polynesia or the Sunda Islands, furnishing support to the idea that the shallow-reef fauna of the Philippines is much the same as in these two places. Light (1914) also calls attention to the "striking similarity between the general littoral alcyonarian fauna of the Philippines and a region so distant as Zanzibar." The fact that four species of *Xenia* found in the Philippines are also found in Zanzibar may possibly lend specific support to the idea.

Although I am in full sympathy with the serious effort of Hickson to reduce the number of species of this genus as much as possible, I cannot avoid adding to the long list of species. All these new forms were described from living or freshly killed material or from both, and the material described as new could not be found to possess sufficient characters to be described as belonging to the already standing species. The following is a short diagnosis of *Xenia* and a synoptic key to the species reported in this paper:

Xenia, family Xeniidæ, without polyp dimorphism, only autozooids present, all arising at the same level from the terminal expanded portion of the stalk.

Key to the Philippine species of Xenia Lamarck.

a^1. Pinnules on internal surface of tentacles.
  b^1. Pinnules in two rows on either side of the inner surface of tentacle.
    c^1. Pinnules in form of low, rounded warts, eight in a row. *X. kükenthali* sp. nov.
    c^2. Pinnules elongate, cylindrical.
      d^1. Pinnules thick, stout, well spaced, ten to twelve in a row. *X. lilliеæ* sp. nov.
      d^2. Pinnules slender, much pointed, fifteen to eighteen in a row. *X. puerto-galeræ* sp. nov.
  b^2. Pinnules in three rows on either side of inner surface of tentacles.
    c^1. Pinnules in the form of very short, small, pointed or rounded cones throughout.
      d^1. Tentacles free throughout, pinnules pointed, twenty-three to twenty-five in a row.......... *X. danæ* Verrill.
      d^2. Tentacles not free throughout, pinnules rounded, seventeen to nineteen in a row.......... *X. intermedia* sp. nov.
    c^2. Pinnules in the form of rounded warts below, longer and cylindrical above.
      d^1. Pinnules eighteen to twenty in a row.......... *X. blumi* Schenk.
      d^2. Pinnules fifteen to sixteen in a row.......... *X. viridis* Schenk.
    c^3. Pinnules more or less elongate throughout.

d^1. Tentacles not free throughout.
  e^1. Tentacle broad, lanceolate.................................. *X. crassa* Schenk.
  e^2. Tentacle narrow, slender.......................... *X. hicksoni* Ashworth.
d^2. Tentacles free throughout.
  e^1. Tentacle axis cylindrical........................ *X. cylindrica* sp. nov.
  e^2. Tentacle axis flattened.
    f^1. Tentacles short, pinnules stout, short...... *X. elongata* Dana.
    f^2. Tentacles long and wide, pinnules long.
      X. fisheri sp. nov.
    f^3. Tentacles long but narrow, pinnules very long and slender.
      X. umbellata Lamarck.
b^3. Pinnules in four rows of pinnules on either side of inner surface.
  c^1. Pinnules in the form of short, stout, much pointed cones.
    d^1. Polyps large, tentacles wide.................................. *X. flava* sp. nov.
    d^2. Polyps large, tentacles narrow, fingerlike.... *X. delicata* sp. nov.
  c^2. Pinnules elongate, more or less filiform.
    d^1. Tentacle not free throughout its length, tentacles short and wide, pinnules low, rounded................ *X. membranacea* Schenk.
    d^2. Tentacle free throughout its length.
      e^1. Polyps large, tentacles long and broad, pinnules very long, rounded at tip .... *X. felicianoi* sp. nov.
      e^2. Polyps small, tentacles short, pinnules slender and shorter, pointed at tip... *X. amparoi* sp. nov.
      e^3. Polyps very tall and slender, tentacles short and narrow, pinnules short, stout and rounded at tip.... *X. schenki* sp. nov.
b^4. Pinnules in five rows on either side of inner surface of tentacle.
  c^1. Spicules absent, color brown............................ *X. sansibariana* May.
  c^2. Spicules present, color bluish gray.......................... *X. mayi* sp. nov.
a^2. Pinnules on both surface of tentacle, one row internally, and two rows externally .... *X. tripartita* sp. nov.

XENIA KÜKENTHALI sp. nov. Plate 1, fig. 1.

Stem much branched, pinnules low, rounded warts in two rows on either side of the tentacle; eight pinnules in a row; spicules absent.

Colony consists of five to six stems arising from a common low base. Stem cylindrical and smooth, varying from 20 to 30 mm long and 8 to 10 mm wide. Apically they divide into two or more branches. The tops of these are enlarged from which the free portions of the polyps arise.

Polyps rather short and stout with bodies 5 to 6 mm long and 3 to 3.5 mm wide, thick looking and not transparent. Tentacles short, stout and rounded at end, 4 to 4.5 mm long and 1.1 mm wide. On either side they are provided with two rows of low, wide, wartlike pinnules, which in some instances can hardly be recognized. Largest ones 0.32 mm high and 0.48 mm wide at base. Outer rows of pinnules situated more toward the external than the internal surface of tentacle. There are usually eight pinnules in a row. Spicules absent. General color pale yellow.

Type: No. 3009–C; 3 colonies, University of the Philippines zoölogical collection.

Locality: Sabang, Puerto Galera, Mindoro.

This differs from *X. lillieæ* in the presence of low, flat, and wide wartlike pinnules, which are much fewer in number. Although its mode of branching and color are similar to those of *X. florida,* the character and number of pinnules easily separate it from the latter as from any other species of *Xenia.* Its uniform, very low, and wide pinnules are distinct from those of *X. ternatana.*

XENIA LILLIEÆ sp. nov. Plate 1, fig. 2.

Colonies with much-branched stem and with well-spaced, stout, cylindrical, thick but pointed pinnules in two rows on either side of the tentacles, ten to twelve in a row.

Stem much branched, bases of different colonies sometimes connected by a long, narrow, cylindrical stolon. Usually basal stem very short, dividing immediately into several branches. Secondary branches in turn divide into two or three terminal branches with a knob-shaped smooth apical surface from which the widely separate free portions of polyps arise. Polyps from 2 to 4 mm apart. Polyp bodies usually from 5 to 12 mm long and 1.8 to 2.5 mm wide. Tentacles 6 to 8 mm long and 1.1 mm wide. Pinnules very stout, cylindrical and nearly pointed, too large for size of tentacles, not very sharply marked off from tentacle axis and well spaced. Two rows on either side of tentacles present, those in a row more or less uniform in size throughout. Ten to twelve pinnules in a row, those on external row being slightly larger than internal; they average 0.64 to 0.72 mm long and 0.4 mm wide.

Spicules numerous, in form of oval or irregular flat and thin discs, 0.023 mm long and 0.014 mm wide or smaller. General color in life is a beautiful lilac, sometimes various tinges of pink.

Type: No. 3003–C, many colonies, University of the Philippines zoölogical collection.

Locality: Sabang, Puerto Galera, Mindoro.

This species differs from *X. florida* in having longer and narrower tentacles and longer and well-spaced pinnules. The other species described as having two rows of small pinnules is *X. ternatana*. In this, however, the stem is unbranched and the pinnules are in the form of warts below becoming slender and pointed. Creeping, slender, and cylindrical stolon when present is very characteristic.

XENIA PUERTO-GALERÆ sp. nov. Plate 1, fig. 3.

Colony branching, polyps tall, tentacle thick, proportionately small, with two rows of slender pointed pinnules, fifteen to seventeen in a row.

Three or more smooth stems arise from a common base 20 mm high and 8 mm in diameter. Stems about 20 mm high and 8 mm wide divide into two terminal branches which have a more or less rounded apical disc from which the polyps arise. Polyps few, usually less than fifty polyps at end of a branch. Polyps rather tall, stout and rigid, with very thick bodies about 10 to 15 mm high and 3 mm in diameter. Tentacles short and small in proportion to size of body, with a cylindrical axis 6 to 8 mm long and 0.9 to 1.0 mm in basal diameter. Pinnules in two rows not closely set on either side of tentacles, whose inner median surface is entirely free. Pinnules fifteen to seventeen in a row, slender, pointed cones, usually 0.7 to 0.8 mm high and 0.2 to 0.29 mm wide. When contracted they may appear as short, stout cones about 0.48 mm long. A few towards base of tentacles rounded and much smaller.

Spicules present but not very numerous, in form of thin, oval discs 0.018 mm long and 0.0108 to 0.0124 mm wide. Color in life light or deep brown.

Type: No. 3015–C, University of the Philippines zoölogical collection.

Locality: Muelle and Second Plateau, Puerto Galera, Mindoro.

This species differs from *X. lilliea* in having a greater number of pinnules, which are slenderer. The consistent color of *X. lilliea*, which is various shades of lilac or violet, is never seen in this species.

XENIA DANAE Verrill. Plate 1, fig. 4.

Xenia florida DANA, Zoophytes (1846) 606.
Xenia danae VERRILL, Am. Journ. Sci. 49 (1869) 283.

Colony small, branching, with small polyps. Base usually 20 mm high with a basal diameter of 10 mm or less. This divides into two or more short branches from upper portion of which polyps arise. Body of polyps 3 to 4 mm long and 1 mm in diameter. Tentacles longer than body, more or less cylindrical and gradually tapering to apex, 5 to 5.5 mm long and 0.4 to 0.48 mm wide at base. Pinnules very tiny, pointed cones in three rows on either side of median inner surface of tentacles which is free throughout its length. Pinnules twenty-two to twenty-five in a row, usually from 0.2 to 0.26 mm long and 0.06 to 0.064 mm wide. Those near base of tentacles mere tiny knobs.

Spicules are numerous, especially under the external surface of tentacles and pinnules.

Stalk and external surface of tentacles light bluish green, while the pinnules are rust brown.

No. 3030–C, University of the Philippines zoölogical collection, from Muelle, Puerto Galera Bay, Mindoro.

The materials here described are probably young colonies, but the branching stem, the shape and the number of small pinnules in three rows, as well as the color appear to agree with the forms described by Verrill from the Fiji Islands.

XENIA INTERMEDIA sp. nov. Plate 1, fig. 5.

Stalk wide, undivided, laterally flattened, polyps medium sized, tentacles narrow, not entirely free, pinnules in form of rounded papillæ basally, longer above, in three or four rows, seventeen to nineteen pinnules in a row.

Stem of colony undivided, with a free base 40 mm high, more or less flattened, with a long diameter of 25 mm and a short diameter of 15 mm. In one colony two fleshy, much-flattened stems arise from a common base. Each is about 30 mm high, 25 mm wide, and 10 mm thick. Polyps on center of expanded disc larger than those at edge. Polyps slender, with bodies 13 to 14 mm long and 1 mm wide. Tentacles narrow, 4 to 5.5 mm long, 0.6 to 0.7 mm wide. Pinnules more or less irregularly arranged. Those at base in form of rounded papillæ in three rows. Apically they become longer and arranged in four distinct rows. Here they measure 0.24 mm high and 0.16 mm wide. Bare median portion of inner surface of tentacle widest at base, where two series of pinnules are 0.4 to 0.5 mm apart. Within a millimeter from tip of tentacles, two series of pinnules come together leaving no bare portion of tentacle. On outer aspect seventeen to nineteen pinnules in a row.

Spicules present, mostly on ectoderm of tentacles and pinnules, in form of tiny biscuits, 0.018 mm long and 0.01 mm wide. Color light flesh pink or grayish pink.

Type: No. 3029–C, University of the Philippines zoölogical collection.

Locality: Medio Island, Puerto Galera Bay, Mindoro.

This species resembles *X. viridis* of Schenk in having rounded warty papillæ basally and longer pinnules above. Unlike it, however, there are four rows of papillæ apically.

XENIA BLUMI Schenk. Plate 1, fig. 7.

Xenia blumi SCHENK, Abh. Senckenb. naturf. Ges. Frankfurt 23 (1896) 65.
Xenia blumi MAY, Jena Zeitschr. f. Naturw. 33 (1899) 81.
Xenia blumi var. *pelsarti* THORPE, Journ. Linn. Soc. 36 (1928) 489.

I am referring to this species several massive colonies which are often very large. In a medium-sized one, the stem is 50 mm high and 30 mm wide. The umbellate disc is much rounded, with a circular outline, about 70 mm in diameter. The polyps are very closely set, forming a mushroomlike moiety. Average-sized polyps have bodies about 10 to 13 mm long and 1.6 to 2.7 mm wide. The largest polyps are as much as 25 mm long (including tentacles) and 1.6 mm wide. The tentacles are relatively short, lanceolate, 5 to 6 mm long and 0.7 to 0.8 mm wide (at base). The pinnules are in three very regular rows on either side of the inner side of the tentacles, leaving a bare median region. There are about eighteen to twenty pinnules in a row. Those situated basally are short, more or less rounded, 0.2 to 0.3 mm long and 0.16 mm wide. Those above are longer, stouter, elongate cones, about 0.5 to 0.6 mm long and 0.2 to 0.3 mm wide.

The stem is fleshlike in color. The body of polyps is very transparent and is of the same color. The tentacles are light blue and the pinnules gray.

Nos. 3044–C and 3002–C, University of the Philippines zoölogical collection, from Puerto Galera Bay, Mindoro.

This species has previously been reported from Ternate (Pacific Ocean), Tonga, East Africa (Indian Ocean), Suez (Red Sea), and Western Australia. Most of our specimens have polyp bodies longer and wider than those described by Schenk from Ternate, although all other measurements are identical. *Xenia blumi* var. *pelsarti* Thorpe should be included in this typical genus. According to Hickson (1921), this form should be merged with *X. plicata* Schenk.

XENIA VIRIDIS Schenk. Plate 1, fig. 6.

Xenia viridis SCHENK, Abh. Senckenb. naturf. Ges. Frankfurt 23 (1896) 62, tab. 2, fig. 4–8.
Xenia viridis ASHWORTH, Willey Zoöl. Results, pt. 4 (1900) 516.

To this species I refer several medium-sized colonies. Stalk undivided, cylindrical, smooth, 30 mm high and 20 mm basal diameter, slightly concave on one side. Disc strongly convex, about 30 mm in longest diameter. Polyps much crowded, medium sized, with bodies 7 to 9 mm long and 1 mm wide. Tentacles about 5 to 6 mm long and 0.6 to 0.8 mm wide. Tentacles free throughout length. Pinnules in three irregular rows on either side of bare medium space of inner surface of tentacles, fourteen to sixteen in a row. Below, they are small and rounded, about 0.32 mm long and 0.16 mm wide or smaller. Those towards the tip are longer, cylindrical with rounded ends, 0.56 mm long and 0.24 mm wide. At places four rows of pinnules may be seen.

Spicules very numerous.

In formalin, stalk is light cream, polyps bluish, pinnules light brown.

No. 3088–C, University of the Philippines zoölogical collection, from Sabang, near Puerto Galera, Mindoro.

This species has been reported from Ternate and New Caledonia. Hickson (1931) believes that it should be merged with the following species.

XENIA CRASSA Schenk. Plate 1, fig. 8.

Xenia crassa SCHENK, Abh. Senckenb. naturf. Ges. Frankfurt 23 (1896) 58, pl. 3, fig. 13.
Xenia crassa ASHWORTH, Willey Zoöl. Results, pt. 4 (1900) 510.

To this species I refer medium-sized colonies with cylindrical stalk, undivided, 28 mm high and 13 mm wide, grooved on either side. Polyps thickly set, medium-sized, with bodies 5 to 6 mm high and 1.5 to 2 mm wide. Tentacles short and wide, about 5 mm long and 0.64 mm wide at base. Pinnules elongate cones, more or less pointed, 0.48 mm long and 0.14 to 0.16 mm wide, densely packed on either side of inner surface of tentacle in two series of three rows each. Two series are together above, but separated below leaving a median bare space. Pinnules sixteen to twenty in a row.

Spicules extraordinarily numerous everywhere under ectoderm, oval or rounded flat discs, 0.0216 to 0.0252 mm long and 0.0108 to 0.0144 mm wide.

Stalk fleshy, capitulum bluish, polyps of same color, pinnules light brown.

Nos. 3071–C and 3011–C, University of the Philippines zoölogical collection, from Sabang, near Puerto Galera, Mindoro.

XENIA HICKSONI Ashworth.

Xenia hicksoni ASHWORTH, Qr. Journ. Mic. Sci. 42 (1899) 248.
Xenia hicksoni KÜKENTHAL, Zoöl. Jahrb. 15 (1902) 648.

Stalk single, cylindrical, tall with small flat base. Stalk about 30 mm high and 10 mm wide, marked with very fine longitudinal ridges. Disc strongly convex on which free portions of polyps are thickly set. Polyps slender but small. Body 6 to 10 mm long and 1 to 1.5 mm wide. Tentacles slender, gradually tapering to a point apically, small in proportion to length of body, 4.5 to 5 mm long and 0.56 to 0.67 mm wide.

Pinnules in two series of three rows each on either side of inner surface of tentacles. Two series separated basally, but about a millimeter from tip they come together leaving no bare median tentacular portion. Pinnules slender, elongate cones, nearly pointed at end. Sixteen to eighteen in a row. Those near middle of tentacle largest, 0.39 to 0.45 mm long and 0.13 mm wide at base. Those toward base of tentacles shorter.

Spicules numerous on body, tentacles, and pinnules, mostly rounded or irregular, tiny, flat, thin discs, 0.0144 to 0.018 mm long and 0.0108 mm wide. Stalk and polyps yellowish cream, pinnules very light brown.

No. 3098–C, University of the Philippines zoölogical collection, from Sabang, near Puerto Galera, Mindoro.

This specimen resembles typical *X. hicksoni* in the size and shape of the tentacles and in the size, shape, and number of pinnules, but the stem is undivided and spicules are present on the tentacles and pinnules, two conditions not found in the type as described by Ashworth.

XENIA CYLINDRICA sp. nov. Plate 1, fig. 9.

Stalk cylindrical, polyps tall, tentacle axis cylindrical, pinnules stout, cylindroid in three closely set rows, eighteen to twenty in a row.

Two cylindrical stalks, 30 to 35 mm high and 20 to 25 mm in basal diameter, bound together basally. Apical end greatly expanded, with a diameter of 35 mm, marked by numerous short ridges. Disc flattened or slightly convex. Polyps not closely set, oldest towards center, youngest along edge of capitulum.

Adult polyps have bodies ranging from 14 to 20 mm in length and 2 to 4 mm in diameter. Axis of tentacles, unlike those of most species of *Xenia*, cylindrical, solid-looking, 7 to 8 mm long, 0.45 mm wide at base, and 0.56 mm at middle. Pinnules elongate, cylindrical and stout, rounded at tip, solid. A number at base short rounded stumps. Largest pinnules just above middle of tentacles, ranging from 0.64 to 0.8 mm long and 0.2 to 0.24 mm wide, in three closely set rows, eighteen to twenty in a row. Sometimes one, two, or three short pinnules are found on external surface of tentacles.

Spicules densely packed under ectoderm in all parts, oval, flat, thick discs with a number of fine circular concentric lines, 0.018 mm long and 0.0126 mm wide.

Stalk and body fleshy or white. Tentacles and pinnules grayish blue.

Type: No. 3076–C, University of the Philippines zoölogical collection.

Locality: Medio Island, near Puerto Galera, Mindoro.

This species, like *X. tumbuatana* May, has cylindrical tentacle axis. It differs, however, from the latter in having larger polyps and numerous spicules. It differs from *X. schenki* in having only three rows of pinnules.

XENIA ELONGATA Dana. Plate 2, fig. 1.

Xenia elongata DANA, Zoophytes (1846) 606.

Xenia elongata WRIGHT and STUDER, Rep. Voy. Challenger **31** (1889) 252.

Xenia elongata KÜKENTHAL, Zoöl. Jahrb. **15** (1902) 649.

To this species I am referring several colonies. Usually two colonies are attached to each other by a short common base about 20 mm long. Stalk of each colony about 45 mm, 18 mm in diameter, usually divided into branches above, yellowish. When expanded, rounded terminal disc polyps of various sizes extend. Those at middle larger, those at periphery smaller and younger. Polyps rather slender with short tentacles. Polyp body very transparent, those full-grown measure from 14 to 20 mm long and 2.5 mm wide.

Tentacles short, with flattened axis, 5 to 7 mm long and 1 to 2 mm wide. Pinnules in two series, on either side of tentacles, with wide bare space between them. Each series composed of three, sometimes four, rows. There are from twenty to twenty-four pinnules in a row, rather flat, short, pointed cones, 0.4 to 0.8 mm long and 0.2 to 0.3 mm wide. Those of outer aspect largest, those of innermost smallest.

Polyp body very transparent, with a bluish tinge. Tentacles brown on inside because of color of pinnules.

Nos. 3041–C and 3012–C, University of the Philippines zoölogical collection, from Puerto Galera Bay, Mindoro.

This form has been reported from Amboina.

XENIA FISHERI sp. nov. Plate 2, fig. 2.

Colony massive, stem smooth and undivided, almost as tall as wide, polyps of medium size, tentacles broad, pinnules elongate in three rows on either side of wide bare median area of inner surface of the tentacle, twelve to eighteen pinnules in a row.

Colony massive, wider than tall. Stem of colony smooth and very fleshy, usually 30 mm high with 28 mm basal diameter, often showing two opposite longitudinal grooves, but at times completely divided into two low branches. Expanded disc about 35 mm in diameter. The polyps, which have an umbellate arrangement, are very much crowded. They have bodies 8 to 12 mm high and 2 mm in diameter. The tentacles are 8 to 9 mm long and 1.6 mm wide at the base, fleshy, stout, and blunt-looking. The pinnules are in two lateral series of three rows, on each side of the very wide, bare, median, inner surface of the tentacles. Tentacles have been seen with only two rows of pinnules on either side. The bare portion is about 1.2 mm wide near the base, narrowing to about 0.32 in the tip. The pinnules are elongate, somewhat digitiform and nearly pointed, the largest being 0.5 to 0.9 mm long and 0.16 to 0.19 mm wide at the base. There are eighteen to twenty-two pinnules in a row.

Spicules are very numerous, densely packed under the ectoderm all over, oval or biscuitlike, flat discs often indented at the sides. They are 0.025 mm long and 0.01 mm wide.

In life the stalk is fleshy, the polyps are white, and the tentacles and pinnules are mostly light blue. The bases of the pinnules, however, have a rust-brown tinge.

Type: No. 3033–C, University of the Philippines zoölogical collection.

Locality: Plateau, Puerto Galera, Mindoro.

Tentacles wider and longer than in *X. elongata* and pinnules shorter than those of *X. umbellata.*

XENIA UMBELLATA Lamarck. Plate 2, fig. 3.

Xenia umbellata LAMARCK, Hist. Nat. An. s. Vert. 2 (1816) 410.
Xenia umbellata SAVIGNY, Desc. de l'Egypte (Hist. Nat., Suppl.) 1 (1817) 228; Atlas Polypes, tab. 1.
Xenia umbellata SCHWEIGGER, Beob. naturh. Reisen (1819) 94.
Xenia umbellata MAY, Jena Zeitschr. f. Naturw. 33 (1899) 82.
Xenia umbellata ASHWORTH, Willey Zoöl. Results, pt. 4 (1900) 513.

Four colonies referred to this species. In two of them (3037–C) each colony is composed of two cone-shaped stems 30 mm long that arise from a short narrow common base about 10 to 12 mm in diameter. Each stem forms a fleshy stalk with a convex expanded disc about 20 mm wide. Polyps sparsely distributed. Oldest polyps at center of disc, the youngest toward periphery. Large polyps have bodies 10 mm long and 2 to 4 mm wide. Tentacles 8 to 9 mm long and 0.8 to 1 mm wide at base. Pinnules very long and slender, closely set in three rows on either side of the free middle line (outer series). The longest are 1.3 mm long and 0.13 mm wide.

In other two colonies (3023–C), main short stem 15 mm high and 10 mm near base, divides into two shorter stems 5 mm long, with a slightly convex disc from which free portions of polyps extend out. There are forty to fifty-five polyps on a single disc. Polyps not closely set, rather short, 10 to 12 mm long (including the tentacles). Tentacle axis cylindrical, about 5 to 6 mm long (excluding the pinnules) and 0.8 mm wide at base, tapering toward apex. Except the shorter ones at base and near tip of tentacles, pinnules very long and slender, 0.96 mm long and 0.13 mm wide, over six to eight times as long as wide, in three rows on either side of bare, middle, inner surface. There are about seventeen to twenty pinnules in a row.

Spicules present, most numerous on ectoderm of pinnules, biscuit-form or more or less circular, 0.014 to 0.018 mm long and 0.01 to 0.018 mm wide.

Rim of disc, as well as surface, beautiful sky blue. Outer surface of tentacles also sky blue but inner surface reddish brown. Entire colony appears in life grayish brown, sometimes bluish gray.

Nos. 3023–C and 3037–C, University of the Philippines zoölogical collection, from Plateau, Puerto Galera Bay, Mindoro.

This form has been recorded from the Red Sea, Indian Ocean (coast of East Africa), and Pacific Ocean (near New Britain). In our examples, the youngest and the smallest polyps I studied measured as little as 2.2 mm in length and 0.8 mm in diameter, and yet these show a distinct pinnulation.

XENIA FLAVA sp. nov. Plate 2, fig. 4.

Colony branching, polyps large, stout, short-pointed cones in four rows on either side of attenuate tentacle, about twenty-two pinnules in a row.

Three short main stems arise from a common irregular base. Stems divide immediately into primary branches, which in turn give rise to secondary branches from which the free portions of polyps arise. Stems as well as the branches irregular in cross section with numerous longitudinal ridges and indentations, soft and weak-looking. Polyps also soft and very transparent, with bodies 13 to 15 mm long and 3 to 4 mm wide. Tentacles 6 to 8 mm long and about 1.2 mm wide at base, the entire inner median surface free from pinnules. This bare space is 0.9 mm wide near base, 0.4 mm at middle, and 0.16 mm near tip of tentacle. Pinnules in four rows on either side, in the form of small, pointed cones 0.48 mm long and 0.19 mm wide at base. There are about twenty-two pinnules in a row.

Spicules numerous everywhere just under the ectoderm, in form of oval or rounded, flat discs with a shallow constriction at opposite sides. Usually about 0.025 mm long and 0.0144 mm wide. Stem deep yellow; polyps yellowish brown.

Type: No. 3006–C, University of the Philippines zoölogical collection.

Locality: Sabang, Puerto Galera, Mindoro.

XENIA DELICATA sp. nov.

Stem branching, polyps small, delicate, and transparent, tentacles slender with four rows of tiny conelike pinnules on either side of the internal surface.

Colony small and delicate-looking, polyps small, tentacles slender. Stalk usually branched. From main base several primary branches arise, which in turn divide into two or three smaller branches from which free portions of polyps arise. Polyps have bodies 5 to 8 mm long and about 1 mm wide. Tentacles fingerlike, slender, 5 to 6 mm long and 0.8 mm wide, free throughout their extent. Pinnules in four rows on either side of inner surface of tentacles. Bare median region of tentacle about 0.5 mm basally, narrowing to 0.16 mm towards tip. Pinnules eighteen to twenty in a row, very small pointed cones, 0.32 mm long and 0.16 mm wide. Largest may be as long as 0.4 mm. Spicules present especially on external surface of tentacles and pinnules. Yellowish brown or greenish brown in life.

Type: No. 3034–C, University of the Philippines zoölogical collection.

Locality: Puerto Galera Bay, Mindoro.

This species is easily distinguishable from *X. hicksoni,* to which it is closest, in having a much more branched stem and in having four rows of pinnules on either side of the wide, bare, median portion of the inner surface of the tentacle.

XENIA MEMBRANACEA Schenk. Plate 2, fig. 7.

Xenia membranacea SCHENK, Abh. Senckenb. naturf. Ges. 23 (1896) 60.

Xenia membranacea MAY, Mitth. Mus. Hamburg 15 (1898) 18.

Xenia membranacea MAY, Jena Zeitschr. f. Naturw. 33 (1899) 86.

Xenia membranacea ASHWORTH, Willey Zoöl. Results, pt. 4 (1900) 512.

Base of colony spreading, often divided into several short, stumpy stems, about 20 mm high and 10 to 15 mm in diameter. Polyps of various ages much crowded on expanded umbellate disc. Young polyps found both at middle and periphery of disc. Free portion of polyp body 7 to 14 mm long and 1.5 to 3 mm in diameter. Tentacles short and stout, 4 to 6 mm long and 0.4 to 0.8 mm wide. Inner surface of tentacle almost covered by pinnules except near base where two series are narrowly separated by a bare strip 0.1 to 0.3 mm wide. Pinnules crowded in three to four rows in each series on each side of tentacle. Pinnules twenty-one in a row, elongate, nearly rounded at tips, the average size being 0.58 mm long and 0.2 to 0.3 mm wide at base.

Spicules very numerous, especially under ectoderm of tentacles and pinnules, biscuit-shaped or oval, 0.022 mm long and 0.014 mm wide.

Stalk yellowish in life, polyps light blue externally, pinnules yellowish gray. Large colonies are deep bluish green or grayish blue.

Nos. 3021–C and 3091–C, University of the Philippines zoölogical collection, Balatero Cove and Paniquian Island, near Puerto Galera, Mindoro.

Previously recorded from Ternate, New Britain, and Zanzibar. Hickson (1931) believes that this form is identical with *X. crassa* Schenk.

XENIA FELICIANOI sp. nov. Plate 2, fig. 6.

Massive colony, stem unbranched, polyp small at base but wide above, tentacles long and wide, pinnules long, slender with rounded ends in four rows of twenty-four to twenty-seven on either side.

Stalk single, thick, much wider apically than basally, height 30 mm, basal diameter 15 mm, diameter of disc 30 mm. Rim of capitulum finely wrinkled. Large polyps towards center of disc, younger and smaller towards periphery. Polyps thickly set, without dimorphism. Bodies of full-grown polyps 12 to 14 mm high, with narrow base, but wider body about 3 mm in diameter. Tentacles long, wide at base, gradually tapering towards tip, 8 to 10 mm long, 1.3 to 1.6 mm wide at base. Pinnules in four rows on either of wide, bare, inner, median surface of tentacle. There may be only three rows towards base. Pinnules twenty-four to twenty-seven in a row, long and narrow with rounded tip, 0.8 to 1.1 mm long and 0.16 mm wide. Those towards the base are shorter.

Spicules present, very numerous under ectoderm of tentacles and pinnules, oval, flat, thin discs about 0.0198 mm long and from 0.01 to 0.0126 mm wide.

Base white, capitulum bluish, tentacles green brown or yellowish.

Type: No. 3010–C, University of the Philippines zoölogical collection.

Locality: Second Plateau, Puerto Galera Bay, Mindoro.

This species has tentacles much wider than, and pinnules more than twice as long as, those of *Xenia schenki.*

XENIA AMPAROI sp. nov. Plate 2, fig. 8.

Colony medium-sized, stalk single or branched, cylindrical. Polyps medium-sized, tentacles proportionately short, pinnules elongate pointed, in four rows of eighteen to twenty-two, on either side of the tentacle.

Colony medium-sized, stalk single or branched or unbranched, cylindrical. Slightly laterally flattened, 40 mm high, with 15 mm basal diameter. Upper portion only slightly expanded, capitulum 20 to 25 mm wide. Side of stalk with a deep longitudinal groove on one side. Polyps thickly set, with bodies tall and transparent, as much as 20 mm long and 2 to 3 mm wide. Tentacles proportionately short and narrow, 5 to 6 mm long and 0.6 to 1 mm wide at base. Pinnules eighteen to twenty-two in a row, long and slender usually, largest from 0.55 to 0.65 mm long and 0.13 to 0.15 mm wide at base. In one colony the pinnules are more or less truncated at tip, probably due to effect of preservation.

Spicules numerous, especially under ectoderm of external side of tentacles and pinnules, oval, rounded, or irregular flat discs, 0.019 mm long and 0.0105 mm wide.

Stalk light whitish yellow, polyps with slight bluish tinge, pinnules light or deep brown.

Type: No. 3051–C, 4 colonies, University of the Philippines zoölogical collection.

Locality: Second Plateau, Puerto Galera Bay, Mindoro.

This species resembles *X. felicianoi* in general color, but the polyps are smaller and the pinnules are shorter and much slenderer and pointed.

XENIA SCHENKI sp. nov. Plate 2, fig. 5.

Colony massive, stalk unbranched, polyps very tall, tentacles narrow, pinnules digitiform, of medium length, in four rows of eighteen to twenty on either side of the inner side of tentacles.

Colony massive, small or large. In a large specimen the stem is single, unbranched, tall and wide, about 70 mm high and 35 mm basal diameter, marked with wide, shallow, longitudinal grooves. Apical end of stem terminates in an expanded, convex disc, about 45 mm in diameter, almost hidden by the polyps. Polyps very tall and slender, many reaching 30 mm long. The body is too narrow for the extent, about 1 to 2 mm wide, except at its base where it may be much inflated to form a swollen portion 4 mm high and 6 mm in diameter. Polyp body is soft and nearly transparent. Tentacle axis of medium length, slender and cylindrical, 5 to 7 mm long, firm, widest at the middle where it is about 0.72 mm wide. One colony has very narrow tentacles about 8 mm long and 0.06 mm wide; each tentacle is almost entirely covered by pinnules on the inside except toward the base where there is a narrow base region about 0.2 mm wide. Four rows of pinnules are present on either side, which almost fill its entire median surface, except for a very narrow bare median area about 0.3 mm wide. There are about eighteen to twenty pinnules in a row. These are closely set, stumpy, about 0.4 to 0.06 mm long and 0.2 to 0.32 mm wide.

Spicules numerous under ectoderm of tentacles and pinnules few on body, biscuit-shaped, oval or narrow thin discs, 0.018 to 0.021 mm long and 0.0077 to 0.0112 mm wide.

Color is whitish yellow or light gray.

Type: No. 3032–C, University of the Philippines zoölogical collection.

Locality: Plateau and Medio Island, Puerto Galera, Mindoro.

XENIA SANSIBARIANA May. Plate 3, fig. 1.

Xenia sansibariana MAY, Jena Zeitschr. f. Naturw. **33** (1899) 87.
Xenia sansibariana KÜKENTHAL, Zoöl. Jahrb. **15** (1902) 655.

I am referring to this species several colonies in our collection. The stem of one, which is unbranched, is more or less dumb-bell-shaped, slightly compressed, with a length of 35 mm, a long basal diameter of about 20 mm, and a small diameter of 15 mm. The distal portion of the stem is in the form of an expanded disc with an elliptical outline, 35 mm long and 18 mm wide. The polyps are crowded. Most of the larger ones are at the center of the disc, the smaller and younger ones mostly at the periphery, although a number are located among the older ones at the center. The larger polyps have bodies 23 to 25 mm long and 3 mm wide. These are quite transparent so that the mesenteries and mesenterial filaments can be readily seen. Ten tentacles are tongue-shaped, about 9 mm long and 1.3 mm wide near the base. The pinnules are in two series of five rows each on either side of the bare median inner surface of the tentacles. This bare space is about 0.64 mm near the base and 0.24 mm towards the tip. The pinnules are long, narrow, and pointed. These are longest at or above the middle of the tentacle where they are about 0.8 mm long and 0.14 wide at the base. There are twenty-eight to thirty pinnules in a row. Spicules absent.

Stalk, body, and axis of tentacle white, pinnules deep or light brown. In life, the colony in position is brownish in appearance.

Nos. 3022–C and 3047–C, University of the Philippines zoölogical collection, from Puerto Galera Bay, Mindoro.

This species was first described by May from materials collected from Zanzibar (Indian Ocean). The type is in the Berlin Museum.

XENIA MAYI sp. nov. Plate 3, fig. 2.

Colony massive, stem low, spreading, single or divided, polyps large, tentacles with five rows of elongate pinnules, twenty-four to thirty-two in a row.

Usually two stalks are joined by a low, wide, common base 20 mm high and 30 mm in diameter. The stalk of each is about

30 mm high and 20 mm in diameter, smooth or marked by a fine or rough longitudinal ridge. On one colony two stalks are fused more or less throughout their length, there is a deep, wide, and smooth groove between them. Polyps are thickly set, the bases of the bodies in close proximity with each other. Young polyps are found both at the periphery and at the middle of the capitulum. Polyps have bodies 12 to 14 mm long and 2 to 3 mm wide. Tentacles are of medium size, almost free throughout their length, 7 to 9 mm long and 1.28 to 1.44 mm wide at the base. Pinnules are elongate, filiform and pointed or rounded at the tips, in five rows on either side of the bare, inner, median surface of the tentacles. The longest, which are toward the middle of the tentacle, are from 0.8 to 0.96 mm long and 0.16 mm wide. Those towards the base are shorter, a few in the form of rounded warts. There are twenty-four to thirty-two pinnules in a row.

Spicules are present everywhere under the ectoderm, especially numerous on body and external surface of the tentacles and pinnules. These are thin, oval or rounded, flat discs with very slight indentations on two sides. They are mostly 0.0216 mm long and 0.0108 to 0.0144 mm wide.

In life the stalk is very light tan, the polyps are light sky blue, and the pinnules are gray.

Type: No. 3054–C, University of the Philippines zoölogical collection.

Locality: Medio Island, near Puerto Galera, Mindoro.

This species resembles *X. sansibariana* in having five rows of elongated pinnules on either side of the tentacles. The presence of spicules and the blue-gray color mark it as a new species.

XENIA TRIPARTITA sp. nov. Plate 2, fig. 9.

Colony with flat spreading stolon, polyps small, thick, tentacles triangular in cross section, with three rows of pinnules, one on the median inner surface and two on the lateral external surface, seven or eight pinnules in a row.

Unlike most species of *Xenia,* the base of the colony is a flat spreading stolon closely applied to coral stones, about 3 to 5 mm thick, irregular in form and extent. Although unusual in form, its stolon agrees with other members of the Xeniidæ in being an extensive cœnenchyme mass uniting the bases of polyps, and pierced by an elaborate and extensive canal system.

Polyps small, more retractile than in most members of the Xeniidæ, not closely set, covering entire outer surface of stolon.

Young polyps situated at middle as well as at edge of spreading base. Polyps short, stout, smooth, and thick walled, about 4 mm high (including tentacles) and 1 to 1.3 mm wide. Tentacles short, thick and fleshy, more or less triangular in cross section with apex of triangle forming internal median surface. They are 1.6 to 2.3 mm long and 0.5 to 0.65 mm wide at base, measured from outside. Three rows of pinnules present, one on median internal surface and one each on lateral external surface of tentacle. In internal row, five to six pinnules, on two external rows, seven or eight. Pinnules stout, thick cones, 0.32 to 0.48 mm long and 0.18 to 0.22 mm wide.

Spicules very numerous, not only in mesoglœa under the ectoderm of polyps but also in mesenteries and in cœnenchyme of stolon. They are oval, flat, thin discs about 0.0216 mm long and 0.0112 mm wide.

In life the stolon and the body of polyps are pale green, and the tentacles greenish blue. .

Type: No. 3038–C, University of the Philippines zoölogical collection.

Locality: Sabang and Puerto Galera Bay, Mindoro.

Genus HETEROXENIA Kölliker

Heteroxenia KÖLLIKER, Festschrift der Physik.-Medicin. Gessellsch., Wurzburg (1875); BOURNE, Phil. Trans. Royal Soc. London (1895) 186; ASHWORTH, Qr. Journ. Mic. Sci. 42 (1899); HICKSON, Barrier Reef Exp. No. 5 4 (1931).

Since Kölliker described the type species of the genus, *Heteroxenia elizabethæ*, in 1875, the existence or nonexistence of polyp dimorphism in the Xeniidæ has given various workers grave concern. The existence of this dimorphic xeniid in Philippine waters was first pointed out by Light (1915), who studied it carefully, although he did not publish any detailed description of the species. When this form was brought to my attention, I decided to study it further in the Puerto Galera region where it is abundant. A cursory examination of the xeniid fauna of Puerto Galera Bay revealed an enormous number of representatives of this genus. As there has been much controversy about it, I took pains to study *Heteroxenia* for three successive summers right at the coast, working on living as well as freshly killed, properly fixed, specimens.

Four xeniid forms have been known to be dimorphic; namely, *H. elizabethæ* Kölliker, *H. capensis* Hickson, *H. rigida* (May), and *H. uniserta* (Kükenthal). The first has been known in the

Philippines, and other dimorphic forms have been found and are here reported as new species of *Heteroxenia.* It should be emphasized that each new species described is based on the study of many specimens, although only one accession number may be named. Other workers are welcome to duplicates of these specimens in case of doubt as to the validity of any species. A short diagnosis and a key to the species from the Philippines follow.

Heteroxenia includes species of the Xeniidæ with two kinds of zooids, autozooids, and siphonozooids present, all arising at the same level from the terminal expanded portion of the stalk.

Key to the Philippine species of Heteroxenia Kölliker.

a^1. Pinnules in the form of rounded knobs.
b^1. Pinnules in two rows on either side of the inner surface of the tentacle which is free throughout.............................. *H. minuta* sp. nov.
b^2. Pinnules in three or four rows, tentacle not free towards the apex. *H. palmæ* sp. nov.
a^2. Pinnules more or less elongated, rounded or pointed at tip.
b^1. Pinnules in two or three irregular rows........ *H. medioensis* sp. nov.
b^2. Pinnules in three very regular rows.
c^1. Pinnules less than 3.5 times longer than wide.
d^1. Tentacle short and narrow, pinnules crowded. *H. elizabethæ* Kölliker.
d^2. Tentacle long and wide, pinnules not crowded. *H. philippinensis* sp. nov.
c^2. Pinnules more than 3.5 times longer than wide.
d^1. Tentacle axis long but wide, pinnules four to five times longer than wide, rounded at end.................... *H. mindorensis* sp. nov.
d^2. Tentacle axis long and slender, pinnules 7 times longer than wide, more or less pointed at end................ *H. lighti* sp. nov.
b^3. Pinnules in four or five rows................................ *H. pinnata* sp. nov.

HETEROXENIA MINUTA sp. nov. Plate 4, fig. 8.

Colony stunted, base triangular, polyps small, tentacles short, narrow, free throughout, pinnules in form of rounded knobs, in two rows on either side, fourteen to sixteen in a row.

Colonies with a base decidedly triangular with apex of triangle attached to rock. Base of triangle in form of expanded disc more or less circular in outline. Base about 20 mm high and 15 mm at expanded upper portion. Disk with slightly convex outer surface from which autozooids and siphonozooids extend out. Autozooids set far apart, spaces between them packed full of siphonozooids. Autozooids smaller than any other species of *Heteroxenia* described, bodies 4 to 5 mm long and 1 to 1.5 mm wide. Tentacles 5 to 6 mm long and 0.8 to 0.9 mm wide, with two rows of rather stout, rounded pinnules on either side of free middle line of inner side. Bare region about 0.2 mm at base, fourteen to sixteen pinnules in a row, 0.3 to 0.4 mm long and 0.2 to 0.3 mm in diameter.

As in other species of *Heteroxenia,* spicules numerous under ectoderm of body of polyps and tentacles, most abundant on outer surface of tentacles and on pinnules. These are biscuit-shaped or oval bodies, 0.018 mm long and 0.014 mm wide.

Siphonozooids small, about 3 mm long and 1.4 mm wide at outer end. Tentacles very short, 0.2 mm long, hardly protruding beyond the apical end of body of zooids. Spicules also found in these zooids, more numerous apically.

Autozooids light fleshy in color, and siphonozooids have chalk white terminal portions.

Type: No. 3019–C, University of the Philippines zoölogical collection.

Locality: Puerto Galera Bay, Mindoro.

This species differs from other species of *Heteroxenia* in having only two rows of much-rounded pinnules.

Heteroxenia capensis of Hickson has usually only one row of pinnules. In some badly contracted ones, the pinnules may appear as if in two rows. The number of pinnules, however, is much less, eight to ten, and the color is brown.

HETEROXENIA PALMÆ sp. nov. Plate 3, fig. 3.

Stalk columnar, single, polyps of medium size, not crowded, tentacles long, slender, not entirely free, pinnules in the form of rounded knobs, in three or four rows, sixteen to eighteen in a row.

Stalk of colony single, undivided, long, columnar, 43 mm long and 15 mm in diameter, marked by deep longitudinal grooves. Terminal disc much rounded, almost ball-like from which two kinds of zooids arise. Autozooids far apart, 10 to 11 mm long and 2 to 2.5 mm wide. Young polyps mostly located along edge of disc. Polyp body marked with eight deep longitudinal grooves. Tentacles slender, 6 to 7 mm long and 0.8 to 1 mm wide. Pinnules rounded knobs, arranged more or less irregularly in two series on either side of tentacle. Basally there are only three rows of very small pinnules, in fact, those at base of tentacles can hardly be discerned. Beginning about middle of tentacle, however, the number of rows in a series increases to four and the inner surface of tentacle is practically covered. There are from sixteen to eighteen pinnules in a row (outermost series). Pinnules much crowded and rounded, about 0.4 mm long and 0.2 mm wide.

Siphonozooids about 2.5 to 3 mm high and 0.7 to 0.9 mm wide. Tentacles mere knobs and without pinnules. They are eight to ten times as numerous as the autozooids.

Spicules present, most numerous on ectoderm of both kinds of zooids, especially apically.

In life, base and autozooids fleshlike in color. Pinnules, however, are brown. The siphonozooids are white.

Type: No. 3027–C, University of the Philippines zoölogical collection.

Locality: Puerto Galera Bay, Medio Island, Mindoro.

This differs from other *Heteroxenia* in having very short, much-rounded pinnules, which are in three rows basally and in four rows apically. The presence of the distinct longitudinal furrows of the polyp body and on the stalk is also very characteristic. It cannot be confused with *Xenia intermedia*, which has a similar type of pinnulation, because of its longer tentacles and wider but shorter polyp bodies.

/ This species is named for Dr. Rafael Palma, president of the University of the Philippines.

HETEROXENIA MEDIOENSIS sp. nov.

Colony small or large with columnar base, polyps of medium size, tentacles free throughout, pinnules of variable length, rounded, short or elongate, in two or three rows, fourteen to eighteen in a row.

Several colonies with columnar slightly flattened stalks about 18 to 30 mm high and with basal diameters 14 by 10 mm. Upper portion of stalk an expanded disc, elliptical in cross section, with the long diameter 23 to 30 mm and the short diameter 15 to 20 mm. Stalk and rim of disc marked by numerous shallow vertical ridges. Large polyps towards the center of disc, younger ones at the edge. Largest polyps have bodies 6 to 9 mm long and 2 mm in diameter. Tentacles 5 to 6 mm long and 0.64 mm wide at base. Pinnules arranged in two series of two or three very irregular rows on either side of bare median inner space of tentacles. In many polyps examined neighboring pinnules are attached to each other. Bare space between two series about 0.3 mm wide on greatest extent of tentacle. Pinnules elongate, rather stout, very variable in length. Longest 0.54 to 0. 64 mm long and 0.16 to 0.2 mm wide. Shorter ones 0.29 mm long and 0.13 mm wide. Those at base are mere knobs.

Fourteen to eighteen pinnules are present in a row (outer aspect).

Siphonozooids closely packed between bases of autozooids. They are about 2.8 mm long and 0.8 mm wide. Apical end only slightly expanded. Here diameter is about 1.08 mm. Tentacles mere slight projections without any pinnules.

Spicules present, most numerous apically in ectoderm of both autozooids and siphonozooids. Stalk and siphonozooids white. Autozooids very pale yellow or light grayish.

Type: No. 3001–C, University of the Philippines zoölogical collection.

Locality: Medio Island, Puerto Galera, Mindoro.

HETEROXENIA ELIZABETHÆ Kölliker. Plate 4, fig. 7.

Heteroxenia elizabethæ KÖLLIKER, Festschrift der Physic.-Med. Gessellsch. Wurzburg (1874) 13; BOURNE, Phil. Trans. Roy. Soc. London 186–B (1895) 476; ASHWORTH, Qr. Journ. Mic. Sci. 42 (1899) 284.

I am referring to this species five colonies with the stem single or divided, 20 mm high and 13 mm in basal diameter. The slightly expanded terminal disc from which free portions of polyps arise is from 18 to 25 mm in diameter. Autozooids closely set, between successive ones there being only one to three small siphonozooids. Autozooids have polyp bodies 5 to 5.5 mm long and 1.5 to 2 mm in diameter. Tentacle short and narrow, 4 to 5 mm long and 0.3 mm wide at base with three rows of pinnules on either side of median bare region of inner surface. There are sixteen to eighteen pinnules in a row, elongate, fingerlike, and rounded at end. Those towards middle and upper part of tentacles are 0.5 to 0.6 mm long and 0.14 to 0.2 mm in diameter, three to four times as long as wide; those below are 0.3 mm long and 0.14 mm wide.

In some specimens (3043–C) the pinnules are stouter, only twice as long as wide, and the two series of pinnules are closer together.

Siphonozooids 1.2 to 1.6 mm long and 0.48 mm in diameter. Upper end slightly expanded, 0.8 to 0.9 mm in diameter, with eight knoblike pinnuleless tentacles.

Spicules numerous all over both types of zooids.

In life the colony appears light gray or ashy gray, sometimes grayish brown.

Nos. 3018–C and 3035–C, University of the Philippines zoölogical collection; from Medio Island and Second Plateau, Puerto Galera Bay, Mindoro.

Although the specimens at hand have shorter polyp bodies than those described by Bourne and Ashworth, the dimensions and proportion of other parts as well as the color agree with typical *H. elizabethæ*. Our specimens, however, have fewer pinnules in a row, sixteen to eighteen. This is the first locality record of this species in the Philippines. It has previously been recorded from Zanzibar (Indian Ocean) and Port Denison (Pacific Ocean).

HETEROXENIA PHILIPPINENSIS sp. nov. Plate 4, figs. 1 and 5.

Colony tall, stalk columnar, polyps slender, tentacles long, pointed, free throughout, pinnules of medium length, rounded, in three rows, twenty-four to twenty-seven in a row.

Species described from one medium-sized colony, among the many we have in our collection. Stem columnar, 43 mm high, with a basal diameter of 13 mm. Apical portion of stem in the form of an expanded, oblong convex disc 34 mm long and 23 mm wide. Autozooids and siphonozooids arise all over the surface as well as from edge of disc. Polyps have slender bodies, the full-grown being about 20 mm long and 2 mm in diameter, semitransparent, with gonads located at bases. Tentacles from 8 to 10 mm long. At base and at middle, they are about 0.96 mm wide, narrowing gradually to a point apically. Pinnules in two series of three rows each on either side of very wide, bare, median, inner surface of tentacles. Those toward the base short, stumpy, and rounded, 0.32 mm high and 0.16 mm in diameter or even smaller. Towards the end of the tentacles they are longer, 0.5 to 0.7 mm long and 0.24 mm in diameter. There are from twenty-four to twenty-seven pinnules in a row.

One colony collected from Sabang Cove, Puerto Galera, has a rather low spreading base. Also polyps have shorter bodies although all other measurements are identical.

Siphonozooids from 2 to 2.9 mm high with a basal diameter of 0.64 mm. Apically they broaden to about 1.2 mm. Tentacles, which are slightly iridescent, more prominent than in other species. They are 0.48 mm wide and 0.5 mm high, more or less triangular in cross section.

Spicules numerous all over, in mesoglœa, just beneath ectoderm of autozooids and siphonozooids. These are oval or irregularly rounded thin discs, 0.018 mm long and 0.014 mm wide.

In life polyps are light brown due to color of pinnules. Stem and body are whitish. Polyp bodies marked with eight very fine longitudinal brownish lines with broken cross lines of the same hue, giving it a checkered appearance. When left in formalin for a long time the entire colony turns yellowish green. The animals are found attached to pieces of dead coral.

Type: No. 3014–C, University of the Philippines zoölogical collection.

Locality: Puerto Galera Bay and Sabang, Mindoro.

This species has much longer polyp bodies and tentacles than most species of *Heteroxenia.*

HETEROXENIA MINDORENSIS sp. nov. Plate 3, figs. 5 and 6; Plate 4, fig. 3.

Colony tall, polyps large, not crowded, tentacles large, axis narrow, pinnules elongate but rounded at end, four to five times longer than wide, in three rows, twenty to twenty-four in a row.

Several tall and slender colonies with high columnar stalks, the largest of which is 25 mm long and 15 mm in its greatest diameter, with circular cross section. Expanded terminal disc also more or less circular in outline, with a rounded surface from which free portions of polyps stand out. Autozooids seem far apart and not crowded. These vary in size; at the center of the disk they are large, at the periphery small. Polyps on the average measure 9 to 11 mm long and 2 to 2.5 mm wide. Axis of tentacles 7 to 8 mm long and 0.9 to 1.2 mm wide at base. Pinnules in two series on either side of bare middle portion of tentacles, there being three distinct rows in a series. Pinnules twenty to twenty-four in a row (outer aspect), elongate, but stout and rounded. They are 0.9 mm long and 0.2 mm wide. Ratio between length and width is 4 or 5 to 1. Those near the base are shorter.

Siphonozooids 2.5 to 3 mm long and 0.5 to 0.6 mm wide with an expanded end about 1 to 1.3 mm wide. Tentacles, free from pinnules, mere knobs about 0.3 mm long.

Spicules present, most numerous under external ectoderm of tentacles of two kinds of polyps.

Stem fleshy, but rest of colony has a light sky-blue tinge.

Type: No. 3036–C, University of the Philippines zoölogical collection.

Locality: Puerto Galera Bay, Mindoro.

This species differs from *Heteroxenia lighti* in having a cylindrical base, less-crowded polyps with taller and wider bodies, and stouter and shorter pinnules that are rounded at the end.

HETEROXENIA LIGHTI sp. nov. Plate 3, fig. 7.

Colony massive, base wide and short, polyps small and crowded, tentacle long and wide, pinnules very long, almost pointed, about seven times longer than wide, in three rows, twenty or twenty-one in a row.

Colony massive, attached to a piece of coral by means of a short, thick, wide, and unbranched stem, circular in cross section, 28 mm high and 35 mm in its largest diameter. Free portion of autozooids very closely set, so that it is often hard to see the small and short siphonozooids between them. Polyp body of autozooids rather small, about 4 to 5 mm long and 1 to 2 mm wide, marked with numerous irregular rings around it. Axis of tentacle, on the average, about 8 mm long and 1.3 mm wide. Pinnules in three distinct and beautifully arranged rows on either side of inner surface of tentacle, leaving a rather wide bare space at median portion. There are twenty or twenty-one pinnules in a row, very long, slender, and much attenuated, almost pointed, 1.3 mm long and 0.2 mm wide. Length about seven times the width. Those near the base are shorter.

Siphonozooids long and slender, 4.5 mm long and 0.7 mm wide. At apical region they are slightly expanded, having here a diameter of 1.5 mm. Tentacles mere knobs, 0.32 mm long and without any trace of pinnules.

Body of autozooids and siphonozooids whitish, but pinnules are greenish yellow. Spicules present, most numerous on autozooids and apical portion of siphonozooids. Autozooids are yellowish; siphonozooids are white.

This species differs from *H. elizabethæ* in having a shorter polyp body, much longer tentacles, and larger, longer, and stouter pinnules.

Type: No. 3024–C, University of the Philippines zoölogical collection.

Locality: Plateau, Puerto Galera Bay, Mindoro.

This species is named for Prof. S. F. Light, who has contributed much to the knowledge of Philippine alcyonarians.

HETEROXENIA PINNATA sp. nov. Plate 4, fig. 9.

Colony large, stalk columnar, polyps large with thick bodies, tentacles shorter but very wide, pointed; pinnules long, narrow, pointed, in four or five rows, thirty-four in a row.

Colony massive, with a thick, tall, columnar, fleshy stem, 70 mm high and 30 mm in diameter, or larger. Long diameter of apical expanded disc 50 mm; short diameter, 35 mm. Two kinds of zooids are much crowded. Autozooids with thick bodies, 12 to

14 mm long and 1.3 to 2 mm wide. Tentacles relatively short and wide with a very short, narrow, terminal portion. Tentacle axis 8 mm long and with a 1.3-mm basal diameter. Pinnules in two series of four or five rows each, leaving a wide, bare, median surface between two series, except at very tip where they are together. Pinnules thirty-four in a row, external aspect much crowded, slender, narrow, and sharply pointed. Most are 0.88 mm long and 0.19 mm wide at base.

Siphonozooids rather slender, 4 to 5 mm high and 0.64 mm wide for greatest extent. Terminal portion where pinnuleless tentacles are situated slightly expanded, about 1.44 mm in diameter. Tentacles 0.6 mm long and 0.32 mm wide, with a tiny brown point on external surface.

Spicules present, few on body of autozooids and siphonozooids, but numerous on tentacles and pinnules.

Pinnules intense brown. Body of polyps and axis of tentacles white.

Type: No. 3017–C, University of the Philippines zoölogical collection.

Locality: Plateau, Puerto Galera, Mindoro.

This is the most numerous *Heteroxenia* in Puerto Galera Bay, growing on old and new pieces of coral. It can easily be recognized among other species because of the featherlike tentacles. The crowded, very numerous, slender, and pointed pinnules constitute a distinctive character.

Genus CESPITULARIA Milne-Edwards

Cespitularia MILNE-EDWARDS, Hist. Nat. des Corall. 1 (1857) 126. Type, *Cornularia multipinnata.*

Cespitularia MAY, Jena Zeitschr. f. Naturw. 33 (1899) 89.

The genus *Cespitularia* was established by Milne-Edwards (1857). It was May (1899), however, who gave a clear definition of the genus through his diagnosis: "Xeniiden von baumformigen Habitus." Unlike *Xenia,* the colony is decidedly branching, and the polyps do not arise from a sharp terminal disc, but at different levels of the stem. According to Kükenthal (1902) there are five void species of the genus; namely, *C. mollis* (Brunden), *C. taeniata* May, *C. coerulea* May, *C. subviridis,* and *C. multipinnata* (Quoy and Gaimard). Recently Thomson and Dean (1931) described a new species, *C. simplex,* from the Siboga Collection. Of these I have found only *C. cœr-*

ulea in the Puerto Galera region in addition to two forms that are apparently new. The following is a short diagnosis of the genus and a key to the three Philippine species of *Cespitularia.*

Cespitularia is a genus of the Xeniidæ without polyp dimorphism, with a treelike habit, the colony decidedly branching, the polyps not arising from a sharp terminal disc but at different levels of the stem.

Key to the Philippine species of Cespitularia Milne-Edwards.

a^1. Pinnules in four rows on each side of the tentacle. *C. quadriserta* sp. nov.

a^2. Pinnules in one row on each side of the tentacle.

  b^1. Tentacle 3.5 to 4 mm long, fourteen to eighteen pinnules in a row. *C. cærulea* May.

  b^2. Tentacle 1.2 to 1.6 mm long, four to seven pinnules in a row. *C. hypotentaculata* sp. nov.

CESPITULARIA QUADRISERTA sp. nov. Plate 4, fig. 2.

Colony dichotomously branched, polyps and tentacles long, tentacles with four rows of conical, wart-shaped pinnules, twenty-four to twenty-six in a row.

Colony consists of several primary basal stems, divided, stout, fleshy, and with prominent longitudinal grooves. Terminal branches short, grouped in threes, arising from secondary or tertiary stems. Polyps arise from different levels of terminal branches; those toward apex largest, those toward base smaller and younger. Majority of full-grown polyps are about 15 mm long (including tentacles). Body of polyps thin, transparent, soft, 9 mm long and 1.5 to 2 mm wide. Tentacles slender and pointed, about 4 to 6 mm long and 0.8 mm wide at base, with cylindrical axis tapering gradually toward apex. Each tentacle bears on either side four rows of regularly arranged pinnules, leaving a clear and distinct space at middle of inner surface. There are twenty-four to twenty-six pinnules in a row (outer series). Pinnules small, pointed cones, 0.2 mm long and 0.1 mm wide at base, longest at middle of tentacle. Proximally and distally they are smaller. Those at base of tentacles are mere knobs or warts. Pinnules of innermost series (toward the middle line of tentacles) usually smaller than those of most external series. Spicules noticeably absent.

When the tentacles are open, the colony appears light brown; but when the tentacles are partly closed the colony looks yellowish green. Base and stems of colony and body of polyps light flesh color. Tentacles yellowish green externally, but the pinnules brownish. General color of colony varies according to the state of contraction of tentacles.

Type: No. 3028–C, University of the Philippines zoölogical collection.

Locality: Puerto Galera Bay and Sabang, Mindoro.

Extensive masses of this species cover old corals just below the low-tide line of Puerto Galera Bay. The only species with which this may be confused is *C. multipinnata.* In the latter, however, the pinnules, which are in three irregular rows, cover the entire inner surface of the tentacle. In the present species the pinnules are in four very regular rows extending from the base to the tip of the sides of the tentacles, leaving a large median portion of the inner surface of the tentacle free from pinnules. The mode of branching is more or less similar to that of *C. coerulea.* In *C. coerulea,* however, there is only one row of pinnules on each side of the tentacle and these are much longer.

This species has longer polyps and longer tentacles than any *Cespitularia* that has been previously described. The pinnules, however, are smaller than those of the other known species.

CESPITULARIA HYPOTENTACULATA sp. nov. Plate 4, fig. 4.

Base spreading, stalk single or branched, tentacles short, with one row of wartlike pinnules, four to seven in a row.

From a spreading base, 35 by 20 mm wide and 22 mm high, six or more cylindrical, single or branched stems, 25 mm high and 10 mm wide, arise. Polyps arise from different levels of stems. Full-grown polyps have long bodies, 6 to 8 mm long and 1.7 to 2 mm wide. Tentacles relatively short, 1.2 to 1.6 mm long and 0.5 to 0.6 mm wide. Only one row of very low, wide, wartlike pinnules on either side of median inner surface of tentacle present. There are from four to seven pinnules in a row.

Spicules absent. In life, stem is bluish and polyps are brown.

Type: No. 3072–C, University of the Philippines zoölogical collection.

Locality: Near Paniquian Island, in Northwest Channel leading to Puerto Galera Bay, Mindoro.

This species has tentacles of the same length as those of *C. taeniata,* but the polyp body is much taller and wider. The polyp body and the number of pinnules are identical with those of *C. subviridis,* but the pinnules are much smaller; in fact, those situated below cannot be seen very well.

CESPITULARIA COERULEA May. Plate 4, fig. 6.

Cespitularia coerulea MAY, Mitth. Mus. Hamburg **15** (1898) 21.
Cespitularia coerulea MAY, Jena Zeitschr. f. Naturw. **33** (1899) 90.
Cespitularia coerulea KÜKENTHAL, Zool. Jahrb. **15** (1902) 659.

Colony branched, growing from a base 30 mm high and 20 mm broad. This gives rise to three or four stems that divide dichotomously into cylindrical branches from different levels of which the polyps arise. Polyps have bodies 4 to 6 mm high and 1 to 1.5 mm in diameter. Tentacles 3.5 to 4 mm long and 0.48 mm wide. Pinnules arranged in one row on either side of tentacle, which is free throughout its length. Above they are elongate, short, fingerlike, about 0.4 to 0.6 mm long and 0.17 mm wide. Below they are shorter. There are fourteen to eighteen pinnules in a row. Spicules absent. Color light flesh tinged with pale blue. After being kept in formalin for some time the specimen turns brownish yellow.

No. 3068–C, University of the Philippines zoölogical collection, from Sabang, near Puerto Galera, Mindoro.

Genus SYMPODIUM Ehrenberg

Sympodium EHRENBERG, Die Korallentiere des roten Meeres (1834) 61; DANA, Zoophytes (1846) 608; MILNE-EDWARDS, Hist. Nat. des Corall. **1** (1877) 110; KLUNZINGER, Die Koralltiere des roten Meeres **1** (1877) 42; WRIGHT and STUDER, Challenger Report **31** (1889) 270; MAY, Jena Zeitschr. f. Naturw. **33** (1899) 47; NUTTING, Proc. U. S. Nat. Mus. **35** (1909) 686; HICKSON, Great Barrier Reef Exp. No. 5 **4** (1931) 174.

The genus *Sympodium* was established by Ehrenberg in 1834. The best diagnosis of the genus was given by Wright and Studer (1889) as follows: "The basis of the colony is a thin but leathery membrane from which the pretty numerous polyps arise; these are short, retractile, and are sunk deeply into the basal membrane. The spicules are very small and disc-like."

No less than twenty-seven different animals have been described as belonging to the genus. Five of these, however, do not properly belong to the genus.

I am acquainted with only one form of *Sympodium;* namely, *S. coeruleum* Ehrenberg. Basing my opinion on this alone, I cannot subscribe to the suspicion of Hickson that "*Sympodium* may be only young growth stages of species of Xenia." I have examined this form from various regions in Puerto Galera Bay and I have not found any indication of them transforming to a stage further than as they are described below. There has been much controversy as to where this genus should be placed. Due to the presence of numerous biscuitlike sclerites all over the colony and due to the existence of numerous pinnules on the tentacles, I am following Hickson in placing this genus under the Xeniidæ temporarily until we know more of its detailed anatomy.

SYMPODIUM COERULEUM Ehrenberg.

Sympodium coeruleum EHRENBERG, Die Korallentiere des roten Meeres (1834) 21; KLUNZINGER, Die Korallenthiere des roten Meeres (1877) 42; WRIGHT and STUDER, Challenger Report **31** (1889) 271; MAY, Jena Zeitschr. f. Naturw. **33** (1899) 51; KÜKENTHAL, Koralltiere des Rothen Meeres, Jena Denschr. **11** (1904) 39; THOMSON and HENDERSON, Trans. Linn. Soc. **13** (1909) 168.

From a very thin basal membrane numerous polyps arise. Base usually encrusted around old dead branches of stag-horn coral, *Madrepora*. Polyp bodies when extended 0.7 to 1 mm high and 0.6 to 0.8 mm wide. Tentacles 1.2 to 1.4 mm long and 0.22 to 0.32 mm wide at middle, more or less rounded and blunt. Pinnules rounded stumpy, in numerous rows around tentacle. They are usually 0.096 mm high and 0.072 mm wide. Sclerites uniformly distributed throughout, in form of tiny, oval discs, like red blood corpuscles, 0.015 mm long and 0.01 mm wide. Colony light blue or sky blue.

Polyps rather contractile. When not properly anæsthetized before fixation, the polyps become partly sunk in small pits from 0.8 to 1.7 mm apart, and only the tips or two-thirds of the tentacles are visible from the surface. The base is usually less than 1 mm thick, but when the colony is fully contracted it may be as thick as 3 mm. This form is very common in Puerto Galera Bay and Sabang Cove, Mindoro, Philippines.

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ILLUSTRATIONS

PLATE 1

TENTACLES OF XENIA, DORSAL AND VENTRAL VIEWS, × 8

FIG. 1. *Xenia kükenthali* sp. nov.
2. *Xenia lilliex* sp. nov.
3. *Xenia puerto-galeræ* sp. nov.
4. *Xenia danæ* Verrill.
5. *Xenia intermedia* sp. nov.
6. *Xenia viridis* Schenk.
7. *Xenia blumi* Schenk.
8. *Xenia crassa* Schenk.
9. *Xenia cylindrica* sp. nov.

PLATE 2

TENTACLES OF XENIA, DORSAL AND VENTRAL VIEWS, × 8, EXCEPT FIG. 9

FIG. 1. *Xenia elongata* Dana.
2. *Xenia fisheri* sp. nov.
3. *Xenia umbellata* Lamarck.
4. *Xenia flava* sp. nov.
5. *Xenia schenki* sp. nov.
6. *Xenia felicianoi* sp. nov.
7. *Xenia membranacea* Schenk.
8. *Xenia amparoi* sp. nov.
9. *Xenia tripartita* sp. nov., × 16.

PLATE 3

TENTACLES, ETC., OF VARIOUS GENERA, × 8

FIG. 1. *Xenia sansibariana* May; tentacles, dorsal and ventral views.
2. *Xenia mayi* sp. nov., tentacles, dorsal and ventral views.
3. *Heteroxenia palmæ* sp. nov.; tentacles, dorsal and ventral views.
4. *Sympodium cœruleum* Ehrenberg; a portion of colony.
5. *Heteroxenia mindorensis* sp. nov.; a siphonozooid.
6. *Heteroxenia mindorensis* sp. nov.; tentacles, dorsal and ventral views.
7. *Heteroxenia lighti* sp. nov.; tentacles, dorsal and ventral views.

PLATE 4

TENTACLES, ETC., OF VARIOUS GENERA, × 8

FIG. 1. *Heteroxenia philippinensis* sp. nov.; tentacles, dorsal and ventral views.
2. *Cespitularia quadriserta* sp. nov.; tentacles, dorsal and ventral views.
3. *Heteroxenia mindorensis* sp. nov.; tentacles, dorsal and ventral views.
4. *Cespitularia hypotentaculata* sp. nov.; a polyp.
5. *Heteroxenia philippinensis* sp. nov.; *a*, siphonozooid; *b*, autozooid.
6. *Cespitularia cœrulea* May; tentacles, dorsal and ventral views.
7. *Heteroxenia elizabethæ* Kölliker; tentacles, dorsal and ventral views.
8. *Heteroxenia minuta* sp. nov.; tentacles, dorsal and ventral views.
9. *Heteroxenia pinnata* sp. nov.; tentacles, dorsal and ventral views.

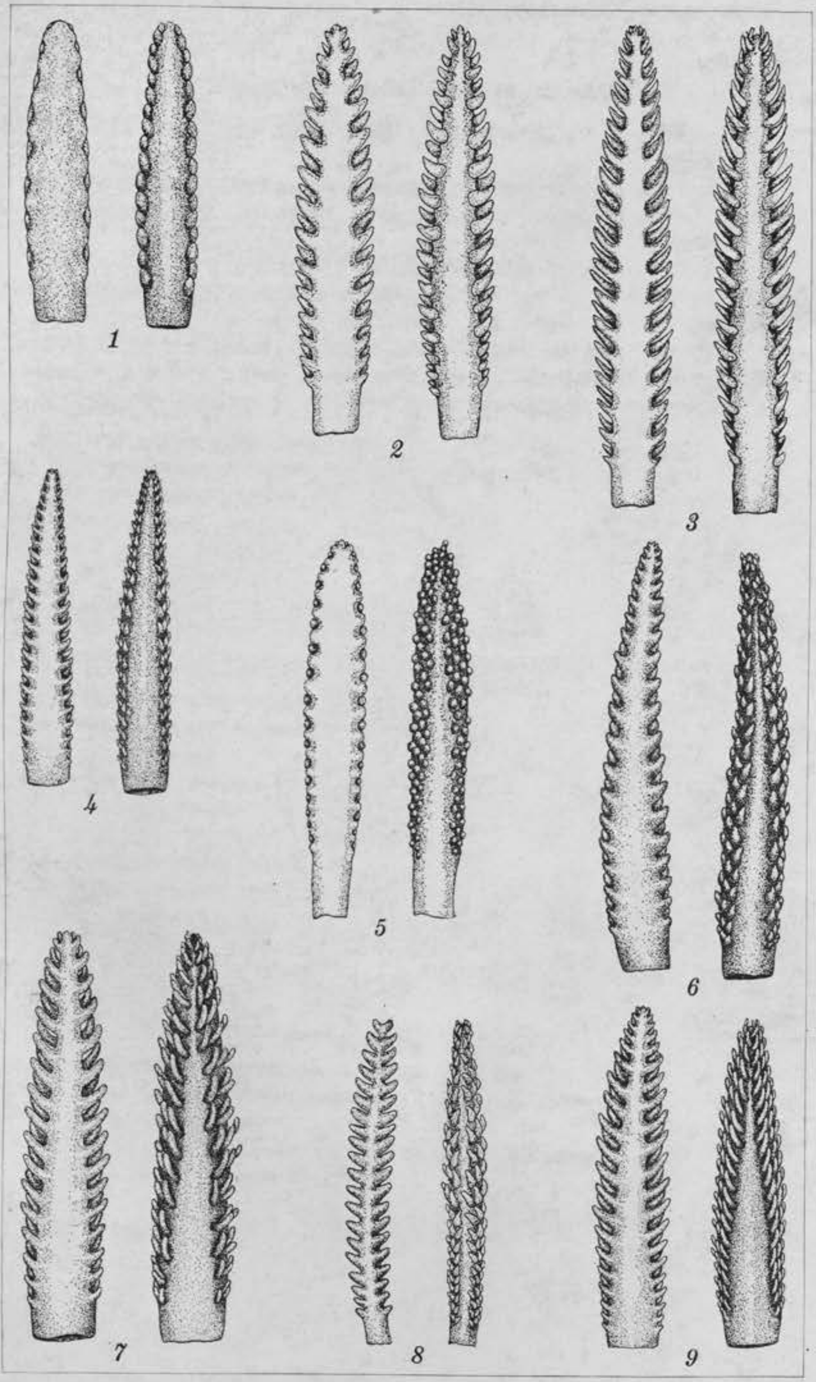

PLATE 1.

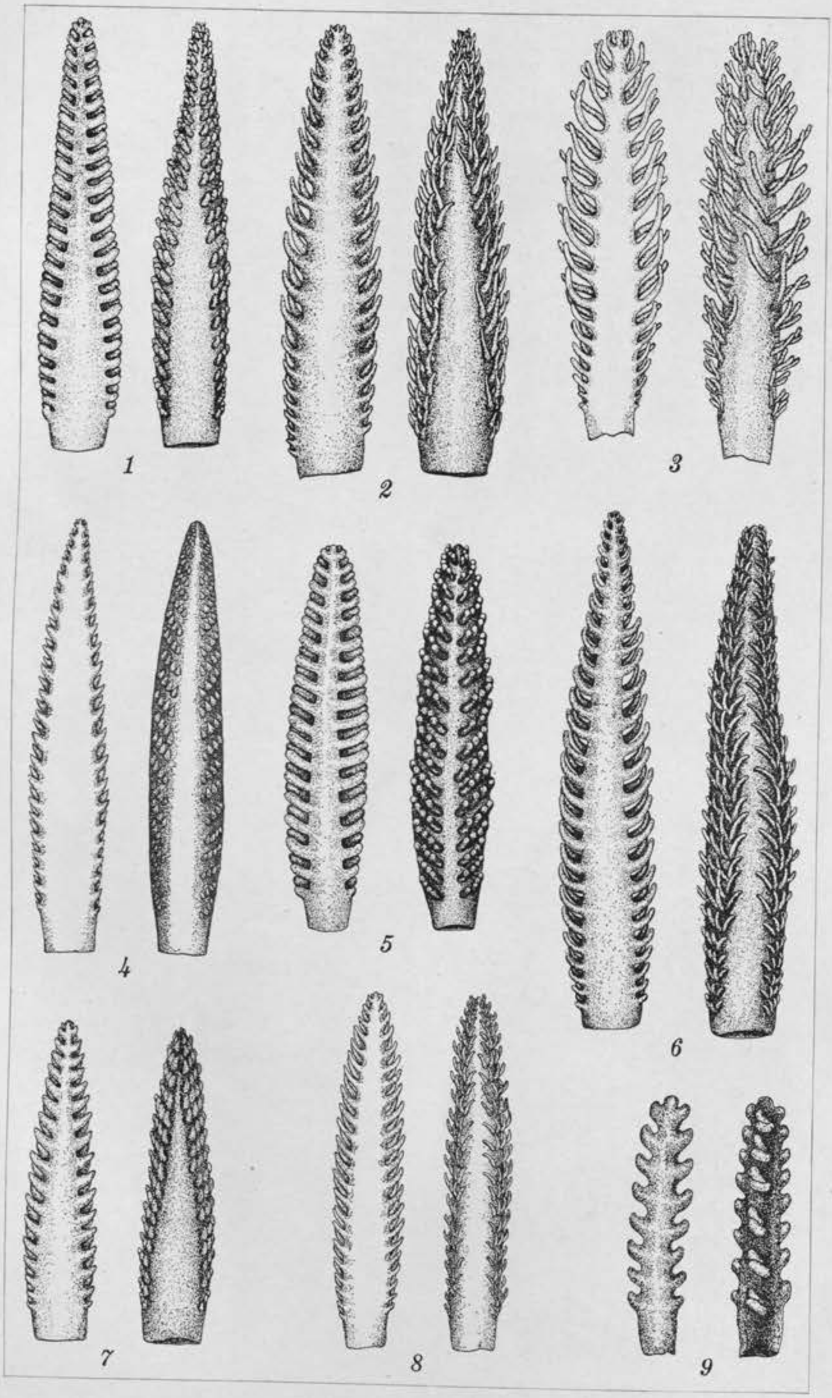

PLATE 2.

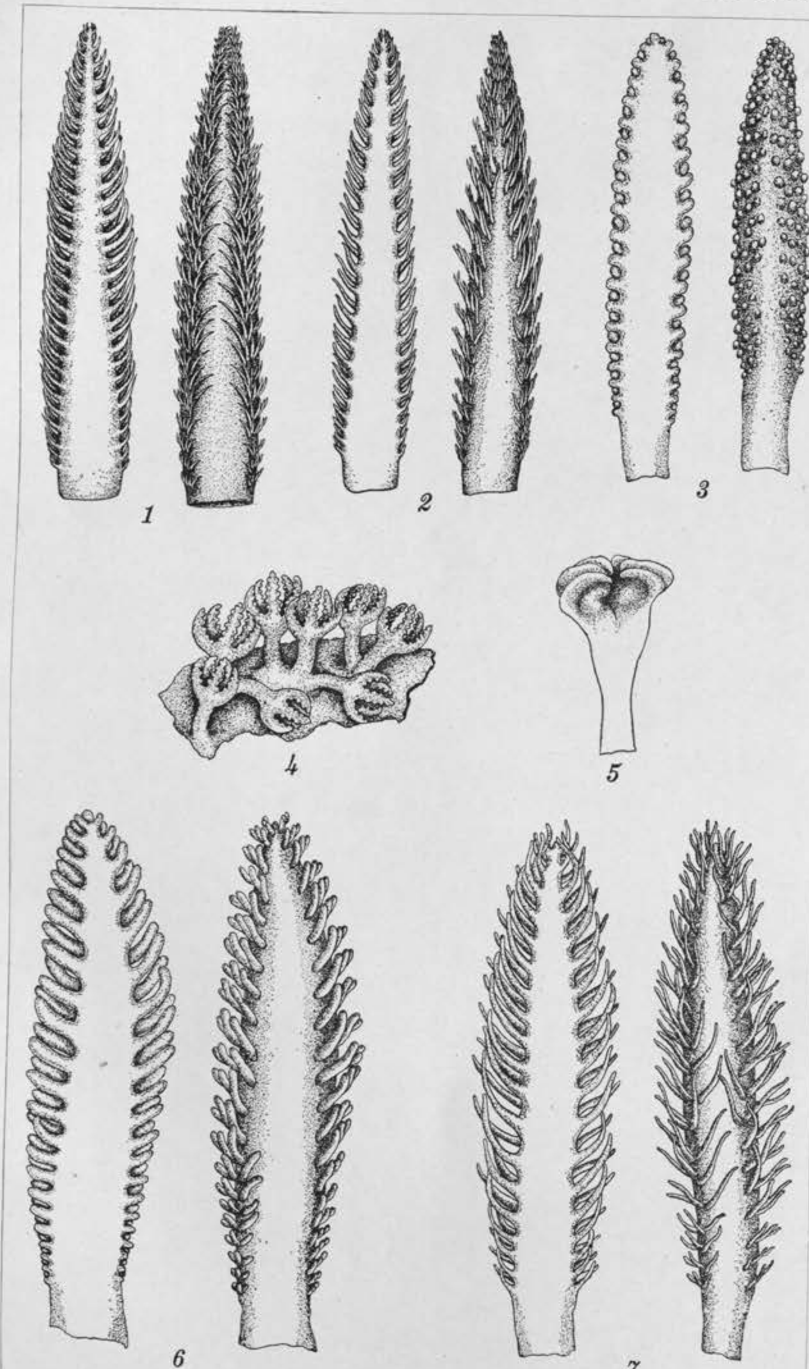

PLATE 3.

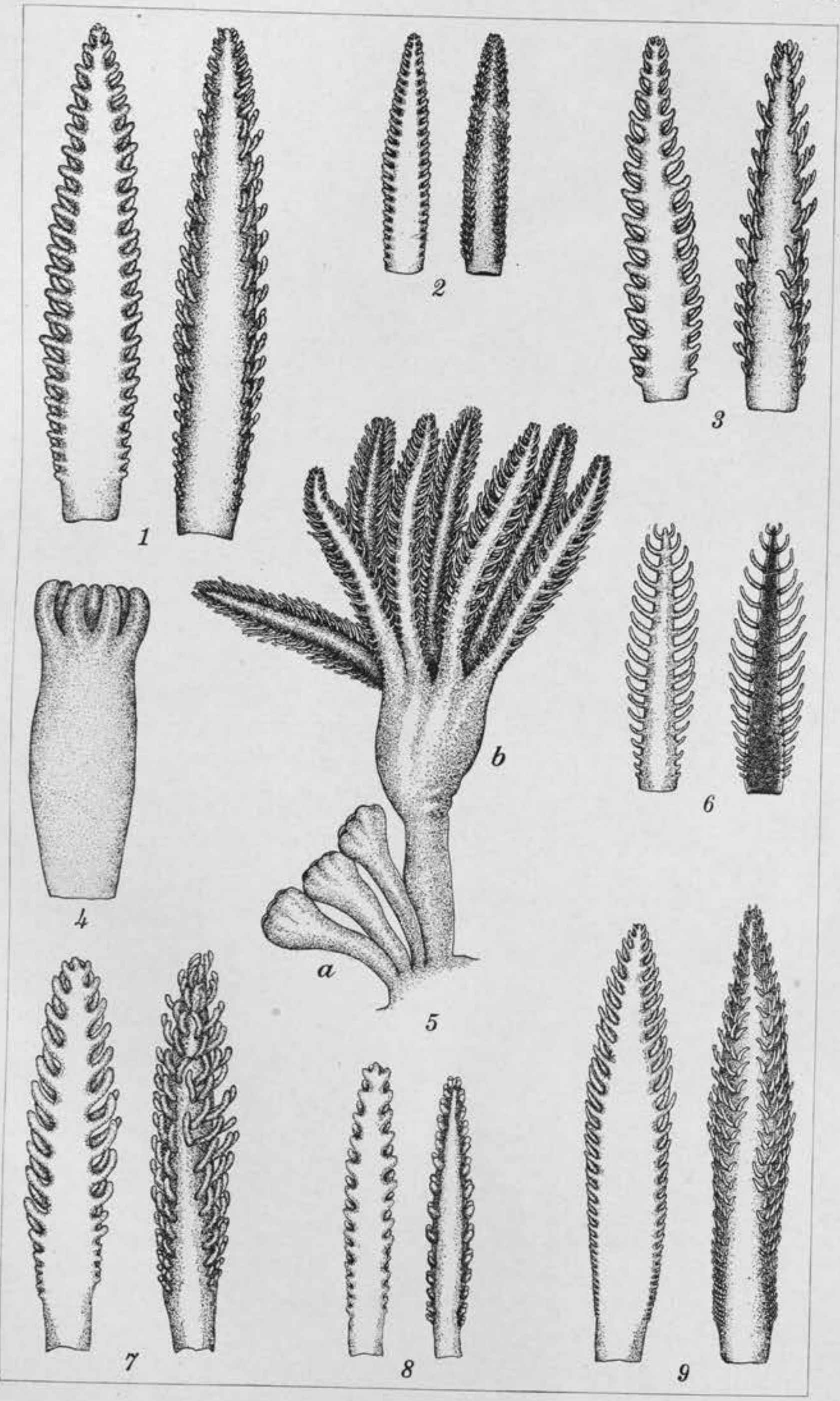

PLATE 4.